

# Bothalia

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# BOTHALIA

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## Three cryptic new species of *Aristea* (Iridaceae) from southern Africa

P. GOLDBLATT\*, A.P. DOLD\*\* and J.C. MANNING\*\*\*

**Keywords:** *Aristea* Aiton, Iridaceae, new species, southern Africa, systematics, taxonomy

### ABSTRACT

Field work in southern Africa over the past several years has resulted in the discovery of three new species of the sub-Saharan African and Madagascan genus *Aristea* Aiton, which now comprises some 53 species. *Aristea* has a pronounced centre in southern Africa and a centre of diversity in the winter rainfall zone of the subcontinent, where all three new species occur, one extending eastward into the adjacent southern edge of the summer rainfall zone. All three novelties have been collected in the past but were confused with related species. *A. elliptica* (subgenus *Eucapsulares*), confused in the past with *A. pusilla* (Thunb.) Ker Gawl., has a more robust habit, usually with 4 or 5 flower clusters per flowering stem, pale blue flowers, smooth ellipsoid seeds with flattened surface cells, and pollen shed as monads, whereas *A. pusilla* usually has 1–3 flower clusters per flowering stem, dark blue flowers, pollen shed as tetrads, and globose seeds with faint foveate sculpturing and colliculate surface cells. *A. nana* (also subgenus *Eucapsulares*), known from few collections, and also confused with *A. pusilla* or *A. anceps* Eckl. ex Klatt, has the unbranched and leafless flowering stem of the latter but has large green floral spathes, flowers borne on long pedicels, and lacks a leaf subtending the single terminal flower cluster in contrast to nearly sessile flowers in *A. pusilla* and *A. anceps*, and in the latter, dry, rusty spathes. *A. cistiflora* (subgenus *Pseudaristea*) closely resembles *A. teretifolia* Goldblatt & J.C.Manning but has linear to narrowly sword-shaped leaves and  $\pm$  secund flowers with the outer tepals only slightly smaller than the inner and with small, dark brown markings at the bases of all the tepals. In contrast, *A. teretifolia* has narrower, sometimes terete leaves and flowers held upright with the outer tepals noticeably smaller than the inner and bearing dark markings covering the lower half, whereas the inner tepals are unmarked.

### INTRODUCTION

In the course of field work in southern Africa, three undescribed species of the sub-Saharan African and Madagascan genus *Aristea* Aiton have come to light. All are spring-flowering species native to the eastern half of the southern African winter rainfall zone and adjacent southern edge of the summer rainfall zone. All have been collected before but have been confused with known species similar in vegetative or floral morphology. Comparison of the taxonomically critical features of the genus, including seeds and pollen grains (Goldblatt & Le Thomas 1997; Goldblatt *et al.* 2004), has substantially aided in distinguishing two of them, *A. elliptica* and *A. nana*, both members of subgenus *Eucapsulares*: section *Eucapsulares* (taxonomy following Goldblatt & Le Thomas 1997). In contrast, details of the flower have shown that *A. cistiflora*, of subgenus *Pseudaristea*, differs from the closely related *A. teretifolia* Goldblatt & J.C.Manning, although its other vegetative and fruiting features accord closely with the remaining members of the subgenus (Goldblatt & Manning 1997a). All species have been examined live in the field as well as in the herbarium. With the addition of these three novelties, *Aristea* comprises an estimated 53 species. Seven species occur in Madagascar (Goldblatt 1991, 1995a) and about 18 in tropical and eastern southern Africa (Weimarck 1940; Vincent 1985), one shared with Madagascar. There are 33 species in the southern African winter rainfall zone (Goldblatt & Le Thomas 1997; Goldblatt & Manning

1997a, b), four of which are shared with eastern southern Africa.

In the descriptions that follow, we ignore the homologies of the subtending foliar bracts of the inflorescence, a binate rhipidium, and call the outer two bract members spathes and those enclosed within them bracts, the latter always smaller than the spathes. The individual inflorescence units, which vary in number and arrangement on the flowering stem, are simply termed flower clusters.

### Subgenus *Eucapsulares* section *Eucapsulares*

*Aristea nana* Goldblatt & J.C.Manning, sp. nov.

Plantae (50–)80–150 mm altae, caule complanato bialato 1.2–2.2 mm lato, nodo terminale elongato, foliis anguste ensiformibus vel linearibus caule pauciter excedentibus, 1.5–4.0 mm latis, marginibus hyalinis saepe rubrescentibus, rhipidio binato unico terminale (1)2-florum, spathis inaequalibus viridibus marginibus siccis hyalinis (13–)15–25 mm longis, bracteis similaribus 6–12 mm longis spathis obtectis, floribus atrocaeruleis, tepalis inaequalibus, externis  $\pm$  10–16  $\times$  3.5–5.0 mm, internis 12–17  $\times$  5.5–11.0 mm, filamentis 3–4 mm longis, antheris  $\pm$  2.5 mm longis flavis, ovario ovoideo 4–6 mm longo, pedicelis 10–12 mm longis, stylo 3-lobato 5–6 mm longis, capsulis ovoideis (6–)10–18 mm longis, seminibusque ignotis.

TYPE.—Eastern Cape, 3323 (Willowmore): hill slopes immediately north of Joubertina (growing with *A. pusilla*), (–DD), 19 Sept. 2004, P. Goldblatt & L.J. Porter 12492 (NBG, holo.; K, MO, PRE, iso.).

Plants (50–)80–150 mm high, sometimes in small tufts; stem flattened and 2-winged, 1.2–2.2 mm wide, one or

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two per plant, with elongate terminal internode up to 90 mm long, occasionally with second short stem up to 30 mm long, stems each with single terminal flower cluster. *Leaves* narrowly sword-shaped to linear, sometimes shortly exceeding stem, 1.5–4.0 mm wide, with narrow translucent margins sometimes flushed red. *Flower clusters* solitary, terminal, (1)2-flowered; spathes unequal, green, acute-attenuate, margins dry and hyaline, (13–)15–25 mm long; bracts similar, 6–12 mm long, enclosed within spathes. *Flowers* on pedicels 10–20 mm long, dark blue, outer tepals green on outside; tepals unequal, outer  $\pm 10\text{--}16 \times 3.5\text{--}5.0$  mm, inner  $12\text{--}17 \times 5.5\text{--}11.0$  mm. *Stamen filaments* 3–4 mm long; anthers  $\pm 2.5$  mm long, yellow; pollen grains shed singly. *Ovary* ovoid,  $\pm 4\text{--}6$  mm long; style 5–6 mm long, 3-lobed at apex,  $\pm 6$  mm diam., lobes lightly fringed. *Capsules* ovoid, (6–)10–18 mm long, on pedicels up to 20 mm long. *Seeds* unknown. *Flowering time*: late July to September, rarely in early October.

*Distribution and ecology*: occurring in Western and Eastern Cape, from Robinson's Pass to the Baviaanskloof, on sandy and rocky sandstone slopes, in arid, marginal fynbos.

A dwarf species, mostly reaching less than 120 mm in stature, *Aristea nana* has until recently rarely been collected and then has usually been confused with similarly low-growing *A. pusilla* (Thunb.) Ker Gawl. When we came across the species in the wild in 2003, growing together with *A. pusilla* near Joubertina, in Eastern Cape, on a slope burned the previous summer, direct comparison of the two in full bloom made it clear that these were different species, despite their similar dwarf growth form and virtually identical flowers. They differ slightly in their leaves, those of *A. nana* having a glaucous bloom and wider translucent margins, whereas the pale green leaves of *A. pusilla* are softer textured. The flowering stem of *A. nana* is almost always unbranched and bears leaves only near the base. The terminal internode is several times longer than the rest of the stem and terminates in a single inflorescence of two or rarely three flowers. Particularly striking are the well-developed pedicels of the flowers, 10–12 mm long, and ovoid ovary, 4–6 mm long, quite different to the short pedicels,  $\pm 2$  mm long, of *A. pusilla* and triangular-columnar ovary, 12 mm long.

Subsequent examination of the pollen of the two species from the Joubertina site showed that *Aristea pusilla* has pollen shed in tetrads, the monads with operculate apertures, as described by Goldblatt & Le Thomas (1997). Pollen of *A. nana*, however, is shed singly, and the grains are dizonasulcate, having two smooth, well-defined apertures at opposite ends of the grain. Once we had determined that *A. nana* was a distinct species, we made a concerted effort in 2004 to establish its range. We found it to be common in the Long Kloof and valleys to the north from Avontuur to Joubertina. We were also able to identify additional collections of *A. nana* in herbaria, where the earliest collections that we have found are those made by R.D. Bayliss in 1974 and mixed with *A. pusilla*. Later collections in herbaria have consistently been misidentified as *A. pusilla*.

Despite their superficial similarity, *Aristea nana* and *A. pusilla* are probably not closely related. Instead, we

believe that *A. nana* is most closely allied to the eastern southern African *A. abyssinica* Pax (currently including *A. cognata* N.E.Br. (Goldblatt 1995b) and *A. anceps* Eckl. ex Klatt. These two species also have unbranched, flattened and broadly winged flowering stems with an extended upper internode, thus bearing leaves only near the base (Weimarck 1940). In addition, *A. nana*, *A. abyssinica*, and *A. anceps* sometimes produce a short stem held close to the base of the plant as well as normal extended flowering stems, a feature not before reported. Some examples are collections of *A. abyssinica* from KwaZulu-Natal (Goldblatt & Manning 9720, MO) and Limpopo in South Africa (Goldblatt & Porter 11954B, MO) and Zimbabwe (Chase 3650, MO) and *A. anceps* (Barker 6991, NBG; Compton 20288, NBG).

Unlike *Aristea nana*, however, both *A. abyssinica* and *A. anceps* have a small subterminal leaf subtending the terminal flower cluster or terminal pair of flower clusters, and rarely a second subterminal leaf 10–20 mm below the flower clusters. *A. anceps* also differs in having the inflorescence spathes and bracts  $\pm$  dry at flowering time, whereas those of *A. nana* are green. Spathes and bracts of *A. abyssinica* are green with broad dry margins at flowering time, later becoming entirely membranous. They also have sessile flowers (pedicels are 2–3 mm long in *A. anceps*), whereas those of *A. nana* have pedicels up to 20 mm long at flowering time, extending to 15 mm in fruit. Moreover, both *A. abyssinica* and *A. anceps* have pollen grains with the apertures obscured by masses of exine (Goldblatt & Le Thomas 1997). The grains were thus termed sulcate; subsequent examination using transmission electron microscopy showed that the apertures are either zonasulcate or disulcate, in either case with a thick intine indicating the location of the aperture (Goldblatt *et al.* 2004). Pollen grains of *A. nana* differ significantly from those of its apparent relatives in having smooth apertures, unique for a species of section *Eucapsulares*. Whereas nearly mature capsules of *A. nana* are known, mature seeds are not, making impossible comparison of the latter character, important in determining relationships in *Aristea* (Goldblatt *et al.* 2004).

#### *Additional material examined*

EASTERN CAPE.—3322 (Oudtshoorn): sandstone slopes at top of Nuwekloof Pass, near Farm Vaalwater, (–BC), 23 September 2004, Goldblatt & Porter 12545 (MO, NBG, PRE); Kouga Mtns, Farm Hoeree,  $\pm 700$  m, (–DB), 29 September 1986, Oelofsen 105 (PRE); 6.7 km E of Joubertina, sandy gravel slopes [growing with *A. pusilla*], (–DD), 24 September 2003, Goldblatt & Porter 12361 (MO, NBG), 3324 (Steylerville) Kouga Mtns, near Doringkloof,  $\pm 900$  m, (–CA), 30 July 1978, Bond 1421 (PRE). [Doubtful locality] 3326 (Grahamstown): Bathurst Dist., grassland (mixed collection, with *A. pusilla*), (–DB), 1 August 1974, Bayliss 6255 (MO).

WESTERN CAPE.—3321 (Ladismith) Gamka Mountain Reserve, Zebra ridge near Oukraal, stony sandstone soil, (–CB), 15 August 1983, Cattell 286 (NBG). 3322 (Oudtshoorn): Robinson's Pass, N-facing slopes in stony ground, (–CC), 22 September 2000, Goldblatt & Nanni 11583 (MO, NBG); Perdepoort N of Camfer, sandstone slopes burned last summer, (–CD), 29 September 2004, Goldblatt & Porter 12572 (MO, NBG); upper Longkloof, rocky sandstone bank burned last summer, (–DD), 18 September 2004, Goldblatt & Porter 12486 (MO, NBG, PRE). 3323 (Willowmore): Antoniesberg, north slopes, (–AD), 30 September 1989, Barker 679 (PRE); W end of the Kouga Mtns, Bokouga road,  $\pm 5$  km from Uniondale, (–CA), 24 September 2003 (fruiting), Goldblatt & Porter 12369 (MO).



***Aristea elliptica* Goldblatt & A.P.Dold, sp. nov.**

Plantae 200–350(–500) mm altae, caule ovoideo leviter bialato 2.5–3.0 mm lato eramoso (2)3 vel 4 inflor-  
escentibus sessilibus ferentibus (raro infima breviter stipitato), foliis linearibus ad ensiformibus usitate (2.5–) 4.0–6.0 mm latis coriaceis glaucis marginibus anguste hyalinis, rhipidio binato 3–5 terminale 2-florum laterali-  
bus usitate 1- vel 2-florum, spathis viridibus marginibus siccis brunneis (25–)30–38 mm longis, bracteis siccis brunneis quam spathis brevibus, floribus pallide caeruleis, tepalis externis 16–18 × ± 7 mm, internis ± 16 × ± 9 mm, filamentis ± 3 mm longis, antheris ± 3 mm longis flavis, ovario triangulo-columnari 12–16 mm longo, pedicelis ad 3 mm longis, stylo ± 6.5 mm longo ad apicem 3-lobato fimbriatoque, capsulis triangulo-cylindricis (20–)24–30 mm longis, seminibus ellipsoideis, in capsulo obliquis.

TYPE.—Eastern Cape, 3326 (Grahamstown): Kariega Park, between Kenton-on-Sea and Salem, stony quartzitic outcrops, (–DA), 21 August 2003, A.P. Dold 4604 (GRA, holo.; MO, NBG, iso.).

Plants 200–350(–500) cm high; stem oval in section and prominently 2-winged, 2.5–3.0 mm wide, normally unbranched, with (2)3 or 4 lateral flower clusters, these sessile or lowermost short-stalked. *Leaves* clustered at base, with 2 cauline leaves, linear to narrowly sword-shaped, (2.5–)4.0–6.0 mm wide, firm to leathery, glaucous, with narrow hyaline margins. *Flower clusters* 3–5, terminal cluster 2-flowered, lateral clusters 1- or 2-flowered; spathes green with membranous, hyaline or brown margins, (25–)30–38 mm long; bracts green to dry, one-third as long as spathes and concealed by them. *Flowers* pale blue, outer tepals with broad green stripe on reverse; tepals unequal, outer 16–18 × ± 7 mm, inner ± 16 × ± 9 mm. *Stamen filaments* ± 3 mm long; anthers ± 3 mm long, smaller after dehiscing; pollen grains shed singly. *Ovary* triangular-columnar, 12–16 mm long, on pedicels up to 3 mm long; style 3-lobed and fringed, ± 6.5 mm long. *Capsules* cylindric and three-lobed, (20–)24–30 mm long; lobes angled. *Seeds* ellipsoid, many per locule, often oriented obliquely to capsule axis in single row, smooth, surface cells ± plane to weakly domed. *Flowering time*: August to October. Figure 1.

*Distribution and ecology*: occurring in Eastern Cape, from the Zuurberg Mountains as far east as the Fish River Mouth, mainly on sandstone slopes and often on rock outcrops, in fynbos or grassy fynbos.

*Aristea elliptica* most closely resembles the diminutive southern Cape species, *A. pusilla*, and was included in what Weimarck (1940) called *A. pusilla* subsp. *robustior* Weim. That taxon is based on a painting of a dark blue-flowered plant called *A. pusilla* in *Curtis's Botanical Magazine* (Ker Gawler 1809). In the absence of an associated specimen, however, it is impossible to establish its identity with confidence. We believe it represents a well-grown specimen of *A. pusilla* but is not distinct from that species, which has the dark blue flowers clearly evident in the painting. However, some collections from Eastern Cape referred to subsp. *robustior* by Weimarck (1940) and later by Vincent (1985), appear

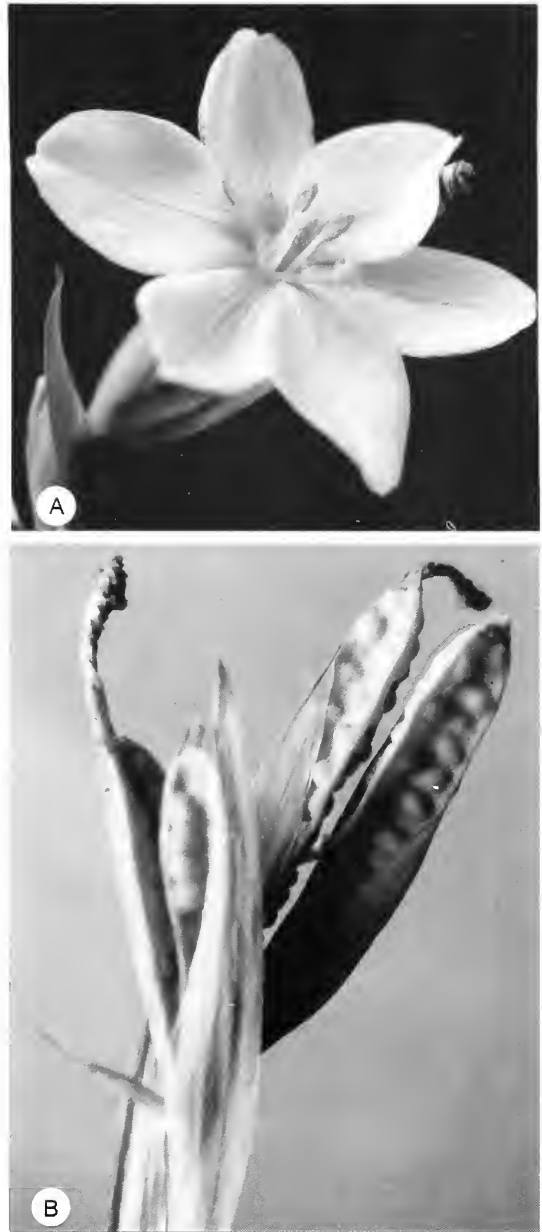


FIGURE 1.—*Aristea elliptica*. A, flower; B, fruit. Photographed from Dold 4604.

very different and, as Weimarck noted, it is difficult to accept these as belonging to the same species. Weimarck's decision to treat the two as subspecies was largely based on the presence of apparent intermediates, which he did not enumerate, in the Uitenhage and Port Elizabeth areas. Vincent (1985) who also recognized *A. pusilla* subsp. *robustior* does list intermediates but some of these specimens are subsp. *pusilla* and others are *A. spiralis* (L.f.) Ker Gawl. (Marsh 660, PRE, from Franschhoek Pass) or *A. aff. pauciflora* Wolley Dod (Oliver 5472, PRE, NBG, from Bailey's Peak, Klein Swartberg Mtns), both of which localities are outside the range of both *A. elliptica* and *A. pusilla*. Measurements

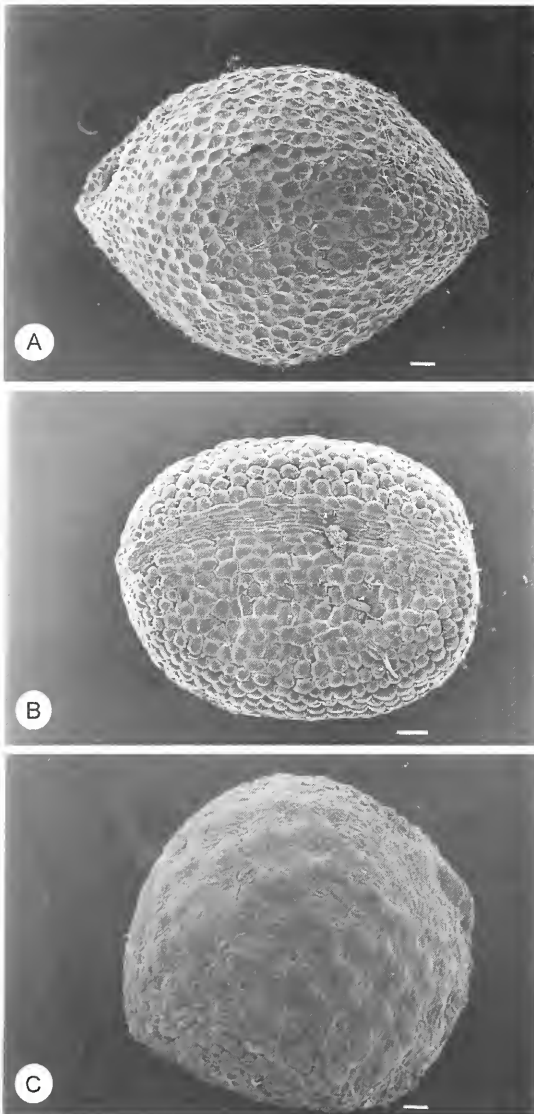


FIGURE 2.—SEM micrographs of seeds. *Aristea elliptica*: A, non-raphe view, Dold 4604; B, with raphe across upper third, Dold 4618; C, SEM micrograph of seed of *Aristea ensifolia*, Goldblatt & Porter 12353. Scale bars: 100 µm.

given by Vincent for subsp. *robustior* mostly do not apply to *A. elliptica*.

While most of these so-called intermediates are merely more robust *Aristea pusilla*, the taller Eastern Cape plants referred to *A. pusilla* subsp. *robustior* represent a second species, recognized at first by its larger size and associated broader stem and leaves, the latter firmer and more leathery than those of *A. pusilla*. More careful examination of these plants shows that they have ellipsoid seeds, unique in *Aristea*, with a smooth surface and surface cell outlines plane or weakly colliculate (Figure 2A, B). The seeds lie in a single row in each locule, as they do in the closely related *A. ecklonii* Baker, *A. ensifolia* Muir and *A. pusilla*, but unlike the horizontally packed seeds in these three species, those of *A. elliptica* are loosely arranged and often oriented obliquely to the long axis of the capsule in a zig-zag arrangement with only their tips touching (Figure 1B). In this arrangement every alternate seed is more or less parallel. These plants also have pollen grains shed singly (Table 1) and they are bisulcate, with two large apertures covered with exine.

Both the seeds and pollen contrast starkly with those of *Aristea pusilla* and its ally *A. ensifolia*. Seeds of these species are depressed-globose to shortly columnar (Figure 2C) (flattened dorsally and ventrally due to pressure from adjacent seeds) with shallow foveate sculpturing and surface cell outlines colliculate to tuberculate (Goldblatt *et al.* 2004). The seeds are vertically stacked, in capsules similar to those of *A. elliptica* but (14–) 20–25(–30) mm long. Pollen of *A. pusilla* is shed in tetrads (Goldblatt & Le Thomas 1997) and the monads are operculate. We have now sampled six populations of *A. pusilla* from across its entire range and confirm tetrads in all of them (Table 1), whereas four populations of *A. elliptica* examined for the feature have disulcate pollen grains shed singly. The latter pollen type conforms to the pattern in most members of section *Eucapsulares* (Goldblatt & Le Thomas 1997; Goldblatt *et al.* 2004).

Typical *Aristea pusilla* is a dwarf plant, usually 80–150 mm high, with fairly soft-textured, pale green leaves mostly 2–4 mm wide, and flowers slightly smaller than those of *A. elliptica*, with outer tepals 12–14 × 7 mm, and inner 9–11 × ± 9 mm versus outer tepals 16–18 × ± 7 mm, and inner ± 16 × ± 9 mm in *A. elliptica*. While *A. pusilla* occurs on both loamy clay and sandy slopes

TABLE 1.—Pollen types in populations of *Aristea pusilla* and *A. elliptica*; all localities are in South Africa. Vouchers are housed at GRA, MO, and NBG

Species	Voucher data	Pollen grains
<i>A. pusilla</i>	W. Cape, Swellendam, Goldblatt & Manning 12256A (MO)	tetrads, monads operculate
	W. Cape, Prince Alfred's Pass, Goldblatt & Porter 12279 (MO)	tetrads, monads operculate
	E. Cape, Joubertina, Goldblatt & Porter 12364 (MO, NBG)	tetrads, monads operculate
	E. Cape, Grahamstown, Bayliss 7635 (MO)	tetrads, monads operculate
	E. Cape, Stones Hill, Grahamstown, Rennie 170 (GRA)	tetrads, monads operculate
	E. Cape, Grahamstown, Van Dam s.n. (PRE)	tetrads, monads operculate
<i>A. elliptica</i>	E. Cape, Kariega Park, Burrows 4658 (GRA)	disulcate with apertural exine
	E. Cape, Kariega Park, Dold 4604 (GRA)	disulcate with apertural exine
	E. Cape, Kowie Nature Reserve, Dold & Cocks 4607 (GRA)	disulcate with apertural exine
	E. Cape, Port Alfred, Tyson 150 (PRE)	sulcate* with apertural exine

\* Pollen grains from Tyson 150, are described as sulcate because we cannot detect the aperture(s) beneath the exine that covers the entire surface.

and extends from Swellendam in the west along the coast and in the Long Kloof to Grahamstown in the east, *A. elliptica* favours rocky sandstone slopes, often occurring in quartzite outcrops and is known from the Zuurberg at Grahamstown and eastward to the Fish River Mouth. The ranges of the two species overlap in the Grahams-town area. Any confusion between the two is most likely the result of depauperate specimens of *A. elliptica* being mistaken for robust plants of *A. pusilla*. Apart from the pollen and seed differences, *A. elliptica* can be separated by the leaves, mostly 4–5 mm wide, leathery and somewhat glaucous, the flowering stem usually bearing at least four flower clusters, the lowermost sometimes short-stalked, and the inflorescence spathes (25–)30–38 mm long. Capsules of *A. elliptica* are elongate, (20–)24–30 mm long, and contain ellipsoid seeds in a single vertical row, with the long axis of the smooth seeds oblique to the long axis of the locules as explained above. The spathes of *A. pusilla* are 16–20 mm long and the stem 1.5–2.0 mm wide.

#### Additional material examined

EASTERN CAPE.—3326 (Grahamstown): Grahamstown, Stones Hill, (–BC), 18 October 1931, J.R. & B.Rennie 179 (GRA); Beggars Bush State Forest, quartz outcrop in grassy fynbos overlooking Beggars Bush Farm, 25 January 2004 (fr.), Dold 4625 (GRA); stony sandstone-derived soil on slopes W of Fish River Mouth near Sherwood turnoff, 20 January 1993 (fruiting), Goldblatt & Manning 9530A (MO); Kariëga Park, 16 km N of Kenton on Sea, (–DA), 14 August 1997, H.H. Burrows 4658 (GRA), 17 September 1994, H.H. Burrows 4113A (GRA); Port Alfred, grassy slopes, (–DB), Oct. 1916, Tyson 150 (PRE); Kowie Nature Reserve, Port Alfred, (–DB), 26 October 2003 (fr.), Dold & Cocks 4607 (GRA, MO).

#### Subgenus *Pseudaristea*

##### *Aristea cistiflora* J.C.Manning & Goldblatt, sp. nov.

Plantae (100–)300–500 mm altae caespitose, caule eramoso raro breviter 1–2 ramoso ovale, foliis linearibus usitate 2.5–3.0 mm latis leviter rotatis, rhipidio binato (1–)4–6 usitate sessilibus 2–4 florum, spathis virides marginibus translucetibus supra siccentibus 15–18 mm longis, bracteis similibus pauca brevibus, floribus pallide roseis ad pallide lilaceis vel cremeis, tepalis externis 22–23 × 13–14 mm, internis 23–25 × 15–17 mm cupreo-brunneis in tertiis proximalibus, filamentis ± 4 mm longis, antheris 5–6 mm longis flavis, ovario oblongo ± 10 mm longo, stylo ± 11 mm longo ad apicem late 3-lobato fimbriato, capsulis elongato lignosis indehiscen-tibus 35–40 mm longis, seminibus triangulato-colum-naribus fimbriato-papillosis ad angulibus.

TYPE.—Western Cape, 3420 (Swellendam): Swellendam, Marloth Reserve, Reservoir Hill, (–AB), 22 August 2003, J.C. Manning 2875 (NBG, holo.; MO, PRE, iso.).

Plants (100–)300–500 mm high, forming tufts up to 150 mm diam.; stem erect, occasionally with 1 or 2 short branches, oval in section. *Leaves* linear to narrowly sword-shaped, mostly 2.5–3.0 mm wide, reaching to middle of stem, loosely twisted. *Flower clusters* (1–)4–6, mostly sessile, each 2–4-flowered; spathes greenish with translucent margins becoming dry above, 15–18 mm long; bracts shorter than spathes. *Flowers* held at 45° to hori-

zontal, large, pale pink to pale lilac or cream-coloured, with bases of tepals darker lilac, violet, or brown, streaked dull brown on outside, outer tepals copper-brown in lower third; tepals unequal, outer 22–23 × 13–14 mm, inner 23–25 × 15–17 mm. *Stamen filaments* ± 4 mm long; anthers 5–6 mm long, yellow; pollen grains shed singly. *Ovary* oblong, ± 10 mm long, weakly curved outward; style broadly 3-lobed and fringed, ± 11 mm long. *Capsules* elongate, woody, indehiscent, 35–40 mm long. *Seeds* triangular-columnar, 1.5–1.8 × ± 1.5 mm, reddish brown, flat at apex and base, fimbriate-papillate along angles, obscurely foveate on faces, surface cells domed. *Flowering time*: August to mid September. Figure 3.

*Distribution and ecology*: Western Cape, on the lower southern slopes of the Langeberg Mtns, in peaty sandstone soil, flowering only after fire or clearing of the veld.

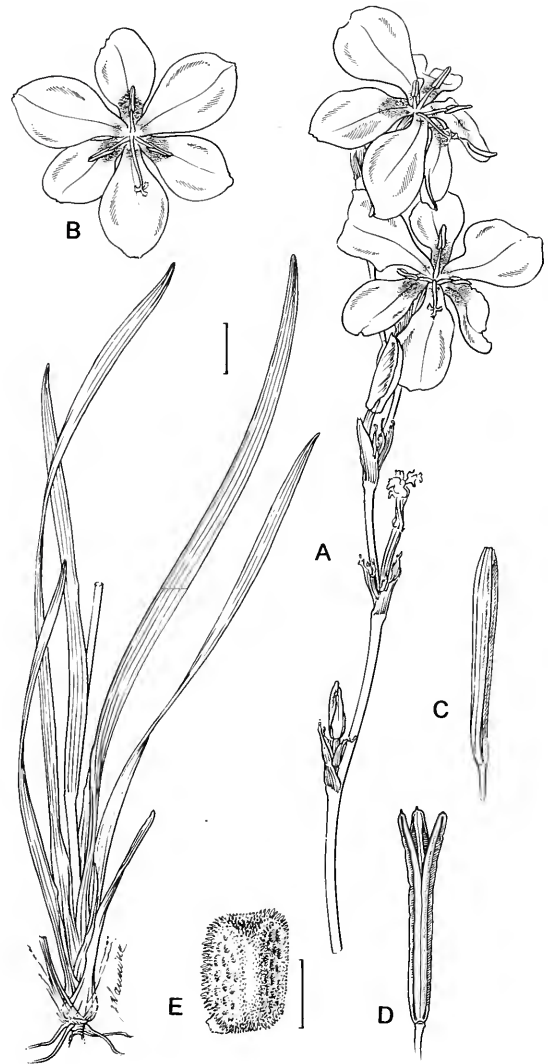


FIGURE 3.—*Aristea cistiflora*, Manning 2878. A, basal leaves and flowering stem showing sessile lateral flower clusters and second flowers; B, flower, front view; C, fresh capsule; D, dry capsule; E, seed. Scale bars: A–D, 10 mm; E, 1 mm. Artist: John Manning.



Evidently first collected by T.M. Wurts in 1952, and only a few times since then, we found *Aristea cistiflora* in 2003, in the spring after a wildfire on the Langeberg near Swellendam, when it became clear that it was an undescribed species. Although Wurts 326 is stunted and only about 100 mm tall, the large, well-pressed flowers are identical to those of the type collection. Interestingly, in 1979 the South African botanist, Dr E.G.H. Oliver noted on the Wurts specimen, 'probably a new species, not described as material inadequate'. His prediction has proved correct.

*Aristea cistiflora* is apparently most closely related to *A. teretifolia* Goldblatt & J.C.Manning (Goldblatt & Manning 1997a), which also has unequal tepal whorls, with oblique outer tepals smaller than the inner and bearing dark basal marks. *Aristea teretifolia* is distinguished by its linear to terete leaves, up to 2 mm wide, flowering stems bearing at most two lateral inflorescences, and by the slightly smaller flowers with the outer tepals  $\pm$  20 mm long and the inner 24–28 mm long, thus substantially longer than the outer, which are abruptly constricted at the base. In *A. cistiflora* the leaves are narrowly sword-shaped, mostly 2.5–3.0 mm wide, the flowering stems bear up to six lateral flower clusters and the inner tepals are only 1–2 mm longer than the outer, which taper gradually toward the base. *Aristea cistiflora* also has larger capsules than *A. teretifolia*, 35–40 mm long versus 20–30 mm long. In general appearance *A. cistiflora* is most likely to be confused with *A. cantharophila* Goldblatt & J.C.Manning but this species has subequal, symmetrical tepals with dark markings at the base of both whorls, dark filaments and exceedingly long capsules, 60–85 mm long.

As in other members of subgenus *Pseudaristea* (Goldblatt & Le Thomas 1997), the pollen grains of *Aristea cistiflora* are dizonasulcate and have reticulate exine and smooth apertures. Recognition of *A. cistiflora* brings the total number of species in subgenus *Pseudaristea* to eight.

#### Additional material examined

WESTERN CAPE.—3420 (Swellendam): Swellendam, base of Crown Mountain, clearing in pines, (–AB), 4 August 1952, T.M. Wurts 285 (NBG); Swellendam; 9 September 1952, T.M. Wurts 326 (NBG); Swellendam, Marloth Nature Reserve, old rather sparse veld near path on 'knol', 10 September 1969, R.A. Haynes H202 (NBG).

#### ACKNOWLEDGEMENTS

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## FSA contributions 18: Salicaceae s. str.

M. JORDAAN†

Deciduous trees or shrubs, sometimes creeping and spreading by suckering, with scaly buds; bark bitter; wood soft and light; plants dioecious. *Leaves* alternate, simple, entire, toothed or occasionally lobed; stipules foliaceous and subsistent, or small and caducous. *In-florescences* erect or pendulous spikes or catkins; bracts membranous, entire, toothed or lacinate, fugacious or persistent, subtending individual flowers, often appearing before leaves. *Flowers* unisexual, regular; perianth absent or represented by a cup-shaped or annular disc or 2 scales or glands at base; nectaries when present, varying in size, shape, colour and number. *Male flowers* with 2–many stamens; filaments filiform, free or  $\pm$  connate; anthers small, ovate or oblong, opening by 2 longitudinal slits; ovary rudimentary or absent. *Female flowers* with ovary superior, sessile or shortly pedicellate, 1-locular; ovules 2–many on each parietal or basal placenta, anatropous, crassinucellar, unitegmic; style short; stigmas 2–4, short, thick, emarginate or 2-fid. *Fruit* a small 2–4-valved capsule, ovoid or oblong, often acuminate. *Seeds* many, very small, with large basal tuft of long, silky, tangled, placental hairs, wind-dispersed, short-lived; endosperm absent or very scanty and oily; embryo small and straight.

A family of two genera and  $\pm$  490 species, chiefly of moist or wet habitats, mainly in the cooler parts of the northern temperate and subarctic zones, scarce, and chiefly in highland areas in the tropics, absent from Australasia and the Pacific Islands. Both genera are represented in southern Africa: *Populus* (introduced species only), and *Salix* (both introduced and indigenous species). *Populus* is grown for matchwood, boxwood and pulp, while both genera are cultivated as ornamental trees and shrubs, for shade, fodder, for their sand-binding properties and as windbreaks. Young twigs and leaves of *Salix* are bitter and astringent, but yield salicin and are the antecedent of modern aspirin. Baskets are made out of the slender twigs of *Salix* species and the best cricket bats are made from the timber of *S. coerulea* E.Wolf.

The taxonomic position of the Salicaceae and its relationship with the Flacourtiaceae are still in dispute, but in this article the family concept is being treated in its narrow sense according to the classification of Cronquist (1981). The flowers of *Populus* are wind-pollinated (anemophilous), whereas those of *Salix* are predominantly entomophilous (Fisher 1928). Meeuse (1975), in discussing the taxonomic position of the Salicaceae, argued that the family underwent several, partly divergent evolutionary processes through which *Salix* became predominantly insect-pollinated and developed nectaries. Fisher

(1928) was the first to describe the flower structure of the Salicaceae s. str. in great detail.

- Terminal buds present, rarely lacking; winter buds with several clearly visible unequal outer scales present; leaves broad, deltoid or broadly ovate, broader than long; petiole longer than 15 mm; catkins pendulous; floral bracts apically serrate or lacinate; male disc cup-shaped or annular ..... \**Populus*  
 Terminal buds lacking; winter buds with only 1 calyprate scale present; leaves narrow, ovate to linear-lanceolate or elliptic, longer than wide; petiole shorter than 10 mm; catkins usually upright; floral bracts entire; male disc of 1 or 2 small distinct glands at base ..... *Salix*

### 1872000 POPULUS\*

\**Populus* L., Species plantarum edn 2: 1034 (1753); L.: 456 (1754); Willd.: 802 (1806); Wesm.: 323 (1868); Benth.: 412 (1880); Pax: 35 (1889); C.S.Hubb.: 340 (1926); Chalmers Smith: 275 (1943); Adamson: 311 (1950); Franco: 54 (1964); Willis: 937 (1973); R.A.Dyer: 30 (1975); Jalas & Suominen: 48 (1976); Coates Palgrave: 91 (1977); Wilmot-Dear: 4 (1985); Wilmot-Dear: 121 (1991); Jordaan: 500 (2000). Type species: *P. alba* L. [lecto. fide Britton & Brown: 587 (1913)].

Small or large trees with pale furrowed bark and soft white wood; branches terete or angled, with terminal buds; winter buds often resinous and aromatic, with several unequal outer scales. *Leaves* mostly broadly ovate to rhombic, long-stalked, entire or dentate; stipules membranous, small, narrow. *Inflorescence* a pendulous, drooping, odourless catkin, appearing before leaves. *Flowers* unisexual, wind-pollinated, borne in axil of a serrate or lacinate bract; perianth reduced to a cup-like disc. *Male flowers* with 4–30 or more stamens; filaments free; anthers 2-theous, oblong to ovate, red. *Female flowers* with ovary sessile or subsessile, 1-locular; ovules many; style very short, 2–4-branched, each branch entire or 2- or 3-fid. *Capsule* 2–4-valved. *Seeds* many, brown, small, ovoid or obovoid, with a tuft of long silky hairs from base.

A genus of  $\pm$  40 species (Wilmot-Dear 1985) and confined to northern temperate and subtropical regions apart from the single East African species *Populus ilicifolia* (Engl.) Rouleau. Natural hybrids are common in the genus, and some have been described as species, e.g. *P.  $\times$  canescens* (Aiton) Sm. It is possible that other named species are in fact of hybrid origin. In southern Africa a few species have been widely cultivated, principally for wood pulp, matches and boxes, e.g. *P. deltoides* W.Bartram ex Marshall (match poplar), which occasionally escapes from cultivation. *Populus* species are often planted to stabilize dongas but they can spread to adjacent streambeds. *P. alba* L. (white poplar) and *P.  $\times$  canescens* (grey poplar) become naturalized, especially in marshy

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\* Naturalized taxon.

MS. received: 1999-04-08.

areas and in river valleys, where they spread by suckering. The latter is now one of the most prominent riverine invaders in southern Africa (Henderson & Musil 1984; Henderson 1989, 1991a, 1992, 1998). *P. nigra* L. var. *italica* (Moench) Koehne also escapes from cultivation, and has invaded rivers in various parts of southern Africa.

### Key to species

- 1a Leaves tomentose or puberulous underneath, margins lobed:
  - 2a Leaves, at least near tip of long shoots, palmately 1-5-lobed and with thick, persistent, distinctly white tomentum below, margin irregularly dentate; flowers sessile ..... 1. *\*P. alba*
  - 2b Leaves obscurely lobed and thinly greyish tomentose below, becoming almost hairless with age below, margin coarsely serrate; flowers pedicellate ... 2. *\*P. × canescens*
- 1b Leaves glabrous, margins serrate or dentate:
  - 3a Branches spreading or ascending; crown broad (Figure 4B); leaves 70–110 mm long, base truncate; glands present at base of lamina; capsules slender-pedicellate ..... 3. *\*P. deltoides* subsp. *deltoides*
  - 3b Branches steeply ascending; habit columnar (Figure 6B); leaves 20–60 mm long, base cuneate or rounded; glands absent at base of lamina; capsules ± sessile ..... 4. *\*P. nigra* var. *italica*

1. *\*Populus alba* L., Species plantarum edn 2: 1034 (1753); Boiss.: 1193 (1879); Fernald: 522 (1950); D.R.Maire: 39 (1961); Franco: 54 (1964); A.Neumann: 12 (1969); L.H.Bailey & E.Z.Bailey: 901 (1976); Jalas & Suominen: 48 (1976); Browicz & Yalt.: 717 (1982); Meikle: 1490 (1985); L.Hend.: 188 (2001). Type: 'Habitat in Europa temperiori', *Herb. Burser XXIII: 19* [UPS, lecto., designated by Jonsell: 78 (1993)].

Tree up to 30 m tall, with trunk up to 1 m or more diam. and branches spreading to form a wide, rounded crown; spreading by root sprouts. *Bark* greyish green to whitish grey and smooth on upper part of trunk and branches, rough and fissured on basal part of old trunks; branchlets at first densely white tomentose, becoming dull grey-brown with age; buds ovoid, blunt, densely white-tomentose. *Leaves* of two kinds: those on short lateral shoots and at base of long leading shoots up to 50 mm long, broadly and bluntly ovate, irregularly bluntly serrate-lobed and thinly tomentose or glabrous; those towards apex of long shoots often deeply palmately 3-5-lobed, up to 125 mm long, persistently white-tomentose below, apex acute, base rounded or subcordate, sometimes with 2 glands, margin toothed, teeth triangular; petioles terete, tomentose, shorter than lamina, 20–42 mm long. *Male catkins* not found in southern Africa. *Female catkins* twice as long as male catkins; pedicels 1–2 mm long; discs ± 1.5 mm diam.; floral bracts dentate, margins with long white hairs. *Female flowers*: ovary 3–5 mm long, tomentose; stigmas with 2 terete, horizontally divergent branches. *Capsules* ovoid, 3–5 mm long, 2- or 3-valved. *Seeds* mostly abortive.

A native of central, E and SE Europe and Asia; now naturalized from plantations in Gauteng, Mpumalanga, Free State and Lesotho (Figure 1). Not as widespread as *P. × canescens*. Spreads by suckering, as only female plants are found in southern Africa (Hubbard 1926). Very difficult to distinguish from *P. × canescens*, of which it is one of the putative parents. See the differences under *P. × canescens*.

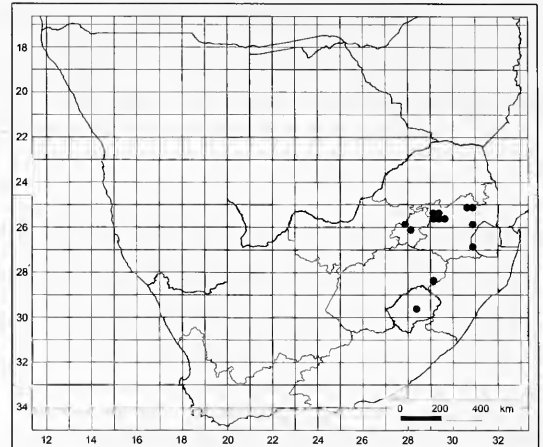


FIGURE 1.—Distribution of *Populus alba* in southern Africa, drawn from SAPIA Database, PPRI, 1979–2005.

Vouchers: Du Plessis 427 (PRE, PRU); Henderson 628 (PRE, PRU), 961, 1010 (PRE); Kluge 888 (PRE, PRU); Theron 1908 (PRU).

2. *\*Populus × canescens* (Aiton) Sm. in Flora Britannica 3: 1080 (1804); Burt Davy: 340 (1921); Burt Davy: 432 (1932); Fernald: 522 (1950); Butcher: 966 (1961); Jalas & Suominen: 49 (1976); Coates Palgrave: 91 (1977); L.Hend.: 189 (2001). Type from Europe.

Tree up to 25 m tall, with moderately spreading crown, often suckering. *Bark* on young stems white, smooth, becoming rough on old trunks. *Leaves* of long shoots deltoid-ovate, cordate, up to 120 mm long, grey-tomentose beneath, becoming almost hairless with age; leaves on short branches, smaller, suborbicular to ovate, obtuse, subcordate, 30–60 mm long; not ciliate, with a narrow translucent border; apex acute, base cordate, sometimes with 2 glands at base, margin irregularly glandular-serrate, ciliate; petiole terete, 15–35 mm long. *Male catkins* 60–100 mm long; stamens 8–15. Figure 2.

A native of Europe and W Asia which has spread to many parts of the world and is now found as an escape from cultivation and established along streams and rivers in the Limpopo Province, North-West, Mpumalanga, Gauteng, Free State, KwaZulu-Natal and Northern, Western and Eastern Cape (Henderson 1991a) (Figure 3).

Commonly known as the grey poplar, it was originally introduced into South Africa to supply the match industry but in the summer rainfall area at least, it has since been replaced by *P. deltoides*. Although originally named as a species, it is apparently a hybrid between *P. alba* and *P. tremula* L. (Browicz & Yaltirik 1982). Only male plants are found in southern Africa, and the plants spread vegetatively by root suckers. A semi-evergreen variety, 'Rossii', also occurs in the area and was originally described as a taxonomic variety by Hubbard (1926), from a specimen collected at the Apies River, Gauteng. It is fast-growing, very frost-resistant and fairly drought-hardy. It differs from *P. alba* mainly in leaf characters: the leaves are

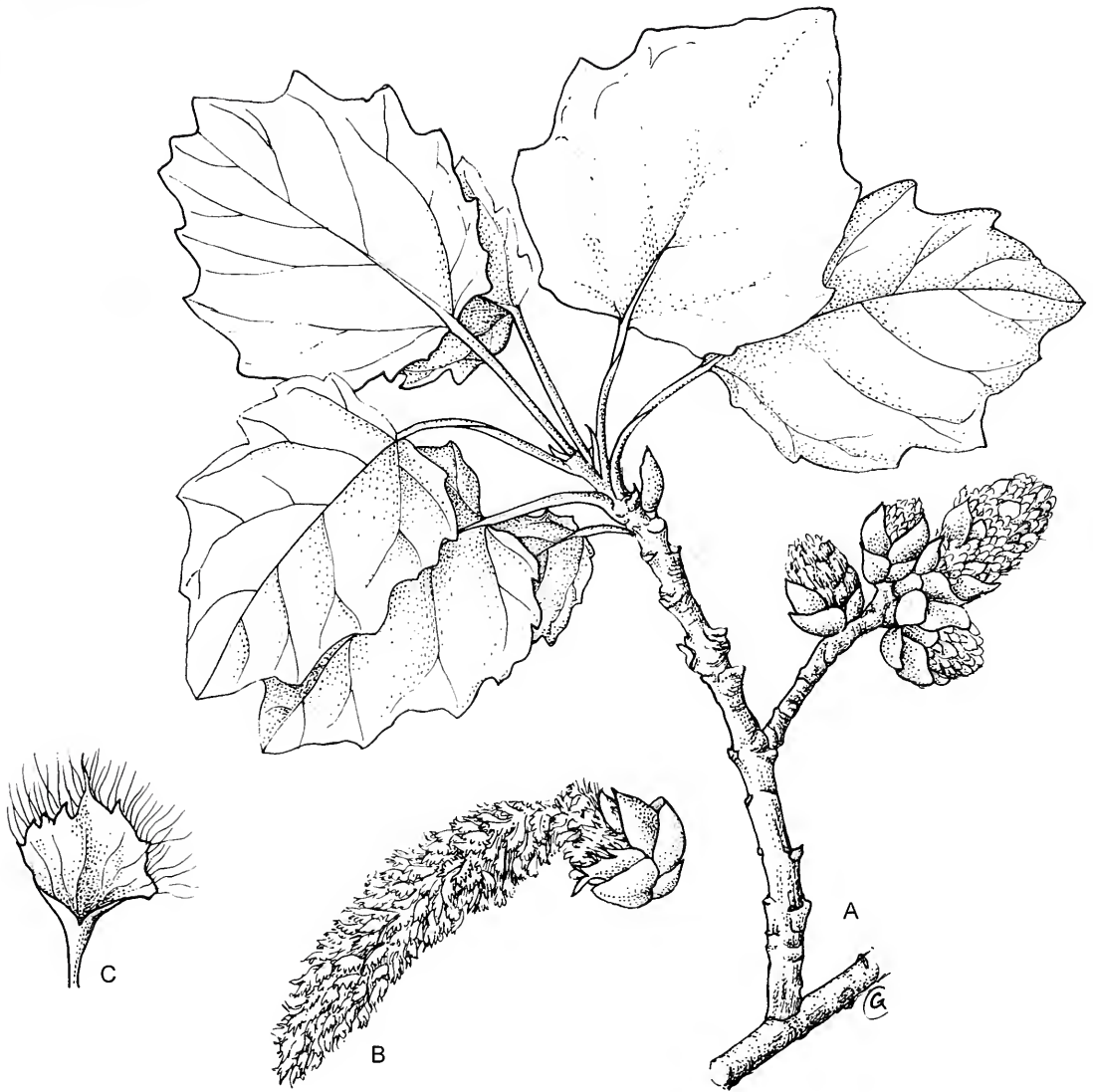


FIGURE 2.—*Populus × canescens*: A, terminal shoot, × 1; B, male inflorescence, × 1; C, floral bract, × 8. A, Jordaen 356 (PRE); B, C, Jordaen 3528 (PRE). Artist: G. Condy.

usually smaller, shorter than 40 mm, not lobed, with four or five coarse, broadly rounded teeth on each side and becoming glabrescent with age below. The leaves of *P. alba* are usually longer than 45 mm, are 1–5-lobed and have more than five, small, irregular, sharp, triangular teeth on each side, with the white tomentum persistent below.

Vouchers: Duggan & Henderson 15 (PRE); Meadows s.n. (GRA); Olivier 1432 (NBG); Parker 3823 (NBG); Potts 4968 (UOVS).

3. *\*Populus deltoides* W.Bartram ex Marshall, *Arbustrum americanum*: 103 (1785); Britton & Brown: 591 (1913); Fernald: 522 (1950); Franco: 55 (1964); L.H.Bailey & E.Z.Bailey: 901 (1976); Eckenw.: 203 (1977); L.Hend.: 190 (2001). Type: United States of America, Carolina and Florida, Bartram s.n. [(BM?, holo., not traced, fide Eckenwalder (1977))].

subsp. **deltoides**

Tree up to 30 m tall, with large, erect trunk, ± 2 m diam.; branches ascending to spreading, forming a broad crown. *Bark* ashy grey, thick, deeply fissured to form broad rounded ridges; branchlets usually stout, glabrous, strongly angular, pale yellowish green to brownish or grey when young, becoming greyish brown with age; buds large, ovoid to ellipsoid, acuminate, resinous, with 6 or 7 scales, outer scales puberulent at base, bright reddish brown, glabrous, 12–30 mm long, crenate-dentate, ciliolate, with 2 or 3 basal glands. *Leaves* deltoid or sub-orbicular-ovate, 70–180 mm long, apex abruptly triangular-acuminate, base truncate, coriaceous, bright green and glossy above, paler beneath, glabrous, turning yellow in autumn, margin irregularly glandular-serrate, with 2 or more large conspicuous glands at point of attachment with petiole; petiole flattened at summit, slender,



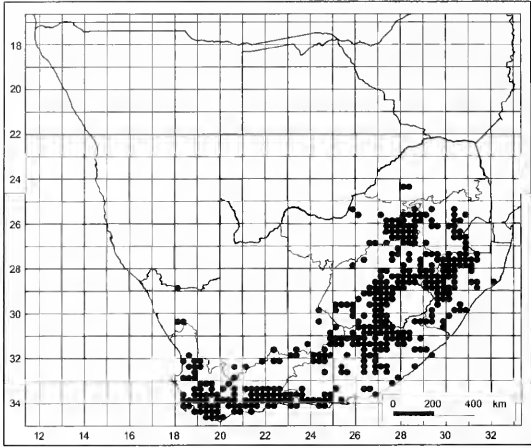


FIGURE 3.—Distribution of *Populus*  $\times$  *canescens* in southern Africa, drawn from SAPIA Database, PPRI, 1979–2005.

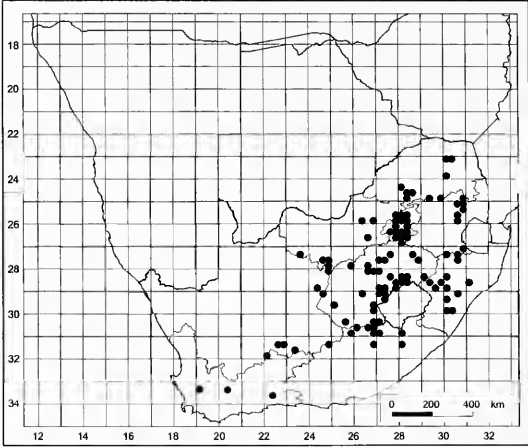


FIGURE 5.—Distribution of *Populus deltoides* subsp. *deltoides* in southern Africa, drawn from SAPIA Database, PPRI, 1979–2005.

pilose becoming glabrous, yellowish or tinged with red, up to 150 mm long. *Male catkins* densely flowered, cylindrical, 70–100 mm long, red and yellow, appearing in spring; pedicels 8–10 mm long. *Male flowers*: stamens 30–60 or more; anthers  $\pm$  1 mm long. Figure 4.

Commonly called match poplar, cottonwood or neck-lace poplar. A native of the United States of America, but is cultivated and occasionally naturalized along water-courses in South Africa (Henderson & Musil 1984; Henderson 1989, 1991b, 1992, 1998) (Figure 5).

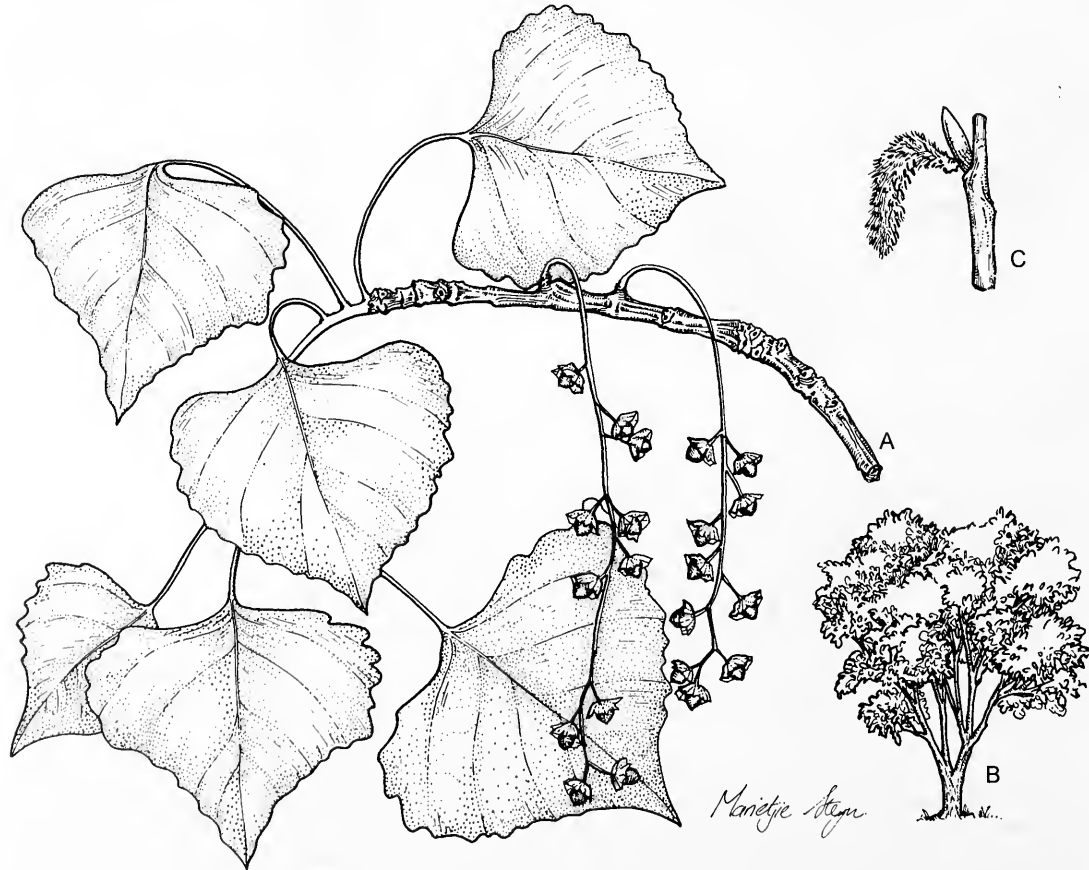


FIGURE 4.—*Populus deltoides* subsp. *deltoides*. A, terminal shoot,  $\times \frac{2}{3}$ ; B, tree outline; C, male catkin,  $\times \frac{2}{3}$ . Artist: Marietjie Steyn. Taken from Henderson (2001), with permission.



FIGURE 6.—*Populus nigra* var. *italica*. A, terminal shoot,  $\times \frac{2}{3}$ ; B, tree outline; C, male catkin,  $\times 1$ . Artist: Marietjie Steyn. Taken from Henderson (2001), with permission.

Vouchers: Gubb KMG10755 (PRE); Henderson 1088 (PRE); Siebert & Siebert 2012 (PRU).

4. \**Populus nigra* L., Species plantarum edn 2: 1034 (1753); Jacot Guill.: 161 (1971). Type: 'Habitat in Europae temperiore' (type not designated).

var. *italica* (Moench) Koehne in Deutsche Dendrologie: 81 (1893), non Du Roi: 2141 (1772), nom. illeg.; Franco: 55 (1964); Bugala: 45 (1967); A. Neumann: 8 (1969); L.H. Bailey & E.Z. Bailey: 901 (1976); Browicz & Yalt.: 719 (1982); Meikle: 1490 (1985); L. Hend.: 191 (2001). *P. italica* Moench: 79 (1785). *P. nigra* subsp. *italica* (Moench) Seemen: 41 (1908); D.R. Maire: 45 (1961). Type: from Lombardy (Italy).

Tree up to 30 m tall, with short trunks up to  $\pm 2$  m diam.; branches steeply ascending and brittle, giving tree a columnar outline; rarely suckering. Bark dark grey and deeply fissured; branchlets terete, glabrous, pale yellow-

ish brown, becoming grey; buds ellipsoid-conic, recurved at apex, resinous, reddish, glabrous, scales with entire margins. Leaves firm, glabrous, yellowish green; lamina rhombic to triangular-ovate, 20–60 mm long, apex abruptly acute to acuminate, base rounded to truncate, margins finely crenate-serrate, eglandular at base; petiole slender, 30–50 mm long, flattened laterally. Male catkins 50–70 mm long. Male flowers: stamens 8–20, red. Figure 6.

Commonly known as the Lombardy poplar, a cultivar from the original species, which is a native of Europe. Infertile and often spreads by means of suckers along watercourses, particularly in the eastern Free State (Henderson 1991a), Lesotho, Western Cape and Eastern Cape (Henderson 1992) (Figure 7).

Vouchers: Du Preez 1929 (PRU); Gibbs Russell, Robinson, Herman & Downing 169 (PRE); Zambatis 169 (PRE).

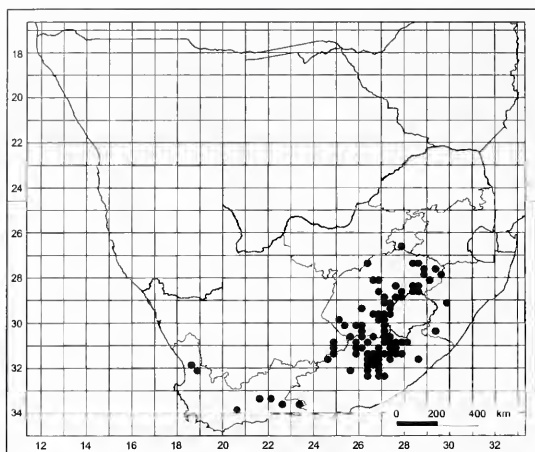


FIGURE 7.—Distribution of *Populus nigra* var. *italica* in southern Africa, drawn from SAPIA Database, PPRI, 1979–2005.

1873000 SALIX

*Salix* L., Species plantarum, edn 2: 1015 (1753); L.: 456 (1754); Willd.: 655 (1806); Thunb.: 30 (1823); Andersson: 1 (1867); Andersson: 190 (1868); Benth.: 411 (1880); Pax: 36 (1889); Boiss.: 1181 (1879); Marloth: 130 (1913); Engl.: 7 (1915); Burt Davy: 62 (1922); Skan: 575 (1925); M.J.Fischer: 307 (1928); Burt Davy: 431 (1932); Adamson: 310 (1950); Ball: 369 (1961); Rech.f.: 43 (1964); Friedr.-Holzh.: 1 (1967); Willis: 1021 (1973); Argus: 2 (1973); Argus: 1613 (1974); R.A.Dyer: 30 (1975); Coates Palgrave: 91 (1977); Wilmot-Dear: 1 (1985); Immelman: 171 (1987); Meikle: 258 (1989); Wilmot-Dear: 120 (1991); McKean: 83 (1996); Jordana: 500 (2000); Coates Palgrave: 121 (2002). Type species: *S. alba* L. [lecto., designated by Britton & Shafer (1908)].

Deciduous trees or shrubs with usually terete branches lacking terminal buds; winter buds each protected by a single calyprate scale, buds sometimes glutinous; branches  $\pm$  flexible. *Leaves* alternate, petiolate or sessile, oblong, lanceolate or linear, entire or serrulate; stipules present or absent. *Inflorescences* dense, usually erect, firm catkins, appearing before or with leaves. *Flowers* unisexual, chiefly insect-pollinated, borne in axil of an entire bract, with 1 or 2 small nectariferous glands at base. *Male flowers*: stamens 2, or in a few species, 3–many; filaments slender, free or sometimes connate, exceeding scale. *Female flowers*: a single ovary, composed of 2 carpels, sessile or stipitate; ovules often 4–8, arranged on 2 placentas; style often short, with 2 short, retuse or bifid stigmas. *Capsule* many-seeded, dehiscent by 2 recurving valves. *Seeds* many, minute, narrowed at ends, dark chestnut-brown or nearly black, enveloped in silky wool; testa white, translucent, surface rough; cotyledons oblong.

A large genus of  $\pm$  450 species (Argus 1997), mostly in temperate parts of the northern hemisphere. One indigenous species with four subspecies occurs in southern Africa and is widespread along rivers; three introduced species have become naturalized. *S. mucronata* subsp. *subserata* (the salsaf willow) occurs in tropical

Africa in the north, from Syria and Egypt, the Arabian Peninsula southwards through East and West tropical Africa following the Nile and the great lakes and along the Congo-Zambezi watershed as far south as the Kunene, Zambezi and Chobe Rivers in Namibia and Botswana. No attempt is made so far to propose an infra-specific classification of *Salix* north of the Limpopo River for tropical Africa, because of very inadequate material as pointed out by Meikle (1958) and Friis (1992). Further south in the FSA region, only three taxa occur, all geographically correlated to their own river groups and drainage lines. *S. mucronata* subsp. *mucronata* (= subsp. *capensis*) occurs in the Orange and Vaal Rivers and their tributaries (North-West, Free State, Lesotho, Northern Cape and southern Namibia) and Western Cape from the Breede River Valley northwards to the Eastern Cape rivers, mainly the Great Fish River Valley, and as far north as the Umzimkulwana River in southern KwaZulu-Natal. *S. mucronata* subsp. *hirsuta* is confined to the Olifants River and probably the Berg River in Western Cape. *S. mucronata* subsp. *woodii* occurs in the northern provinces of South Africa, in Swaziland, KwaZulu-Natal and Lesotho.

The indigenous *Salix* species in southern and tropical Africa are sometimes difficult to identify because of the dimorphic character of their leaves, which is not always the case with the introduced and naturalized species. Two types of leaves are produced in different seasons. The first spring leaves are usually smaller, broader in proportion to their length, often obovate instead of ovate or lanceolate, with margins entire instead of toothed, apex often rounded instead of acute. The summer leaves which follow, often remain on the branches until pushed off by the swelling buds in their axils, hence these trees are sometimes almost evergreen (Newsholme 2002). Owing to this overlap of leaf characters (leaf shape and proportion), the complete geographical separation, with subspecies restricted to certain drainage basins, is therefore the most distinctive character to use for the infra-specific classification of *Salix mucronata*.

Camus & Camus (1904) classified the European species of *Salix* into sections, mainly on account of the number of nectaries and number of stamens. *S. babylonica* and *S. fragilis* with two nectaries and 4–12 stamens and pubescent filaments belong to section *Fragilis* Koch, and *S. caprea* with one nectary and two stamens belongs to section *Capreae*. Argus (1997) published a new infrageneric classification of *Salix* and placed *S. fragilis* in *Salix* subgenus *Salix* sect. *Salix*. *S. babylonica* belongs to *Salix* subgenus *Salix* sect. *Subalbae* Koidzumi and *S. caprae* to *Salix* subgenus *Vetrix* (Dumort.) Dumort. sect. *Cinerella* Seringe. There has never been any attempt made to place the African species *S. mucronata* in any section. With its nectary represented by an irregularly lobed ring, or sometimes reduced to one abaxial and one adaxial gland and 5–8 stamens, it may constitute a section of its own.

Some species of *Salix*, e.g. *S. babylonica*, *S. fragilis* and *S. mucronata*, are classified as rheophytes, which in nature are confined to the beds of swift-running streams and rivers where they grow up to flood level, but not beyond the reach of regularly occurring flash floods (Van Steenis 1981).



Key to species and subspecies (see Figures 8 & 9)

- 1a Branches hanging  $\pm$  vertically; leaves tapering to a long-acuminate apex; stipules persistent, at least 8 mm long; female flowers sessile ..... 6. \**S. babylonica*
- 1b Branches ascending, spreading or droopy but not hanging vertically; leaves rounded, acute or acuminate but not tapering to a long apex; stipules varying; female flowers and fruits usually pedicellate:
- 2a Stipules usually  $\pm$  present, foliaceous or linear, at least 3 mm long:
- 3a Catkins pedicellate; mature leaves usually not wider than 15 mm and longer than 45 mm ..... 7. \**S. fragilis*
- 3b Catkins subsessile; mature leaves usually wider than 20 mm and not longer than 40 mm ..... 8. \**S. caprea*
- 2b Stipules absent or very soon caducous, minute, only up to 0.3 mm long:
- 4a Leaves and branches densely silver-hirsute; found along the Olifants River and probably the Berg River (Western Cape) and their tributaries ..... 5b. *S. mucronata* subsp. *hirsuta*
- 4b Leaves and branches glabrous or grey-canescens; not found along the Olifants River and probably the Berg River (Western Cape):
- 5a Leaves (10–)15–40 mm wide; found in N Namibia and Botswana ..... 5d. *S. mucronata* subsp. *subserrata*
- 5b Leaves 4–10(–15) mm wide; absent in N Namibia and Botswana:
- 6a Summer leaves usually shorter than 55 mm; petioles 2–5 mm long; twigs always glabrous; found mainly along Orange and Vaal Rivers and their tributaries and rivers in Western and Eastern Cape as far north as southern KwaZulu-Natal ..... 5a. *S. mucronata* subsp. *mucronata*
- 6b Summer leaves usually longer than 60 mm; petioles 4–14 mm long; twigs grey-canescens to puberulous, sometimes glabrous; found mainly along the Limpopo, Olifants, Maputo, Komati, Umbuluzi, Tugela and Black and White Umfolozi Rivers and their tributaries ..... 5c. *S. mucronata* subsp. *woodii*

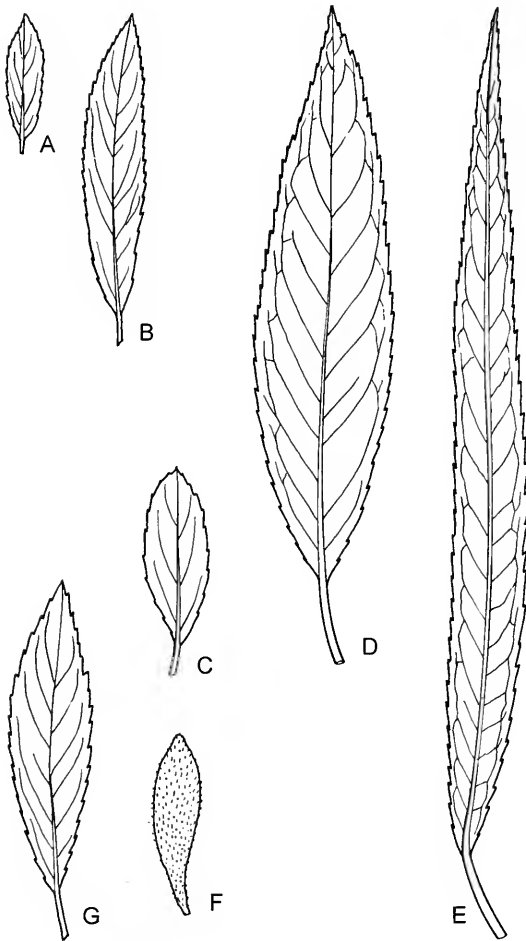


FIGURE 8.—Leaves of *Salix mucronata*. A, spring leaf of subsp. *mucronata*,  $\times 1$ ; B, summer leaf of subsp. *mucronata*,  $\times 1$ ; C, spring leaf of subsp. *subserrata*,  $\times 1$ ; D, summer leaf of subsp. *subserrata*,  $\times 1$ ; E, summer leaf of subsp. *woodii*,  $\times 1$ ; F, spring leaf of subsp. *hirsuta*,  $\times 1$ ; G, summer leaf of subsp. *hirsuta*,  $\times 1$ . A, *Berry KMG13218* (PRE); B, *Gubb KMG10847* (PRE); C, *Merxmüller & Giess 30494* (PRE); D, *Roux 332* (NBG); E, *Dieterlen 6718* (SAM); F, *Middlemost 1733* (NBG); G, *Van Jaarsveld 4496* (NBG). Artist: G. Condy.

5. *Salix mucronata* Thunb., *Prodromus plantarum capensium*: 6 (1794); Willd.: 685 (1806); Thunb.: 31 (1807); Andersson: 14 (1867); Burt Davy: 70 (1922); Friis: 154 (1992); McKean: 84 (1996); Coates Palgrave: 121 (2002); R.H.Archer & Jordaan: 92 (2005). Type: Cape, *Thunberg s.n. UPS23065* [lecto., designated by Immelman (1987), IDC microfiche 1063/968!].

Tree with branches ascending or drooping, slender or stout. *Bark* dark grey or brown, becoming deeply vertically fissured with age; branches glabrous or with dense grey canescence, becoming glabrous with age, often reddish when young. *Leaves* dimorphic, small, entire spring leaves followed by much larger toothed ones, broadly lanceolate to elliptic, 25–160  $\times$  3–15 mm, apex long acuminate to acute to obtuse, base cuneate, usually discolorous, silvery hairy to puberulous to glabrous, soon glabrous on both surfaces or only above, margin entire, subentire, denticulate or serrate, reticulate venation slightly visible above, hardly visible beneath; petiole slender or stout, 3–15 mm long, glabrous or pubescent, often reddish; stipules small, falling soon, serrulate, glandular on adaxial surface, often absent. *Inflorescence*: flowers arranged in dense spikes or catkins. *Male catkins* 34–70 mm long; bracts usually pubescent, sometimes densely so, or sometimes glabrous; gland an irregularly lobed ring, sometimes reduced to one abaxial and one adaxial gland, 0.3–1.0 mm long. *Male flowers* appearing from midwinter to spring and again in late summer; stamens 5–8. *Female catkins* 20–35 mm long. *Female flowers* on pedicels 2–4 mm long. *Capsules* 4–6 mm long, dehiscent to release tufted, woolly seed; fruiting stipe 1.5–3.5 mm long. *Seeds* ovoid,  $\pm 1$  mm long.

5a. subsp. *mucronata*. Immelman: 173 (1987).

*S. capensis* Thunb. var. *mucronata* (Thunb.) Andersson: 14 (1867); Andersson: 198 (1868); Sim: 329 (1907); Skan: 577 (1925).

*S. capensis* Thunb.: 31 (1807); Harv.: 309 (1838); Andersson: 197 (1868) excl. vars. *mucronata*, *hirsuta*; Sim: 328 (1907); Marloth: 130 (1913); Skan: 576 (1925) excl. var. *mucronata* & syn. *S. aegyptiaca*; Burt Davy: 432 (1932); Von Breitenbach: 72 (1965); Friedr.-Holz.: 14 (1967); Jacot Guill.: 161 (1971); Palmer & Pitman: 413 (1972); Newsholme: 59 (2002). *S. mucronata* Thunb. subsp. *capensis* (Thunb.) Immelman: 173 (1987); Jordaan: 255 (2002a); Jordaan: 122 (2002b).

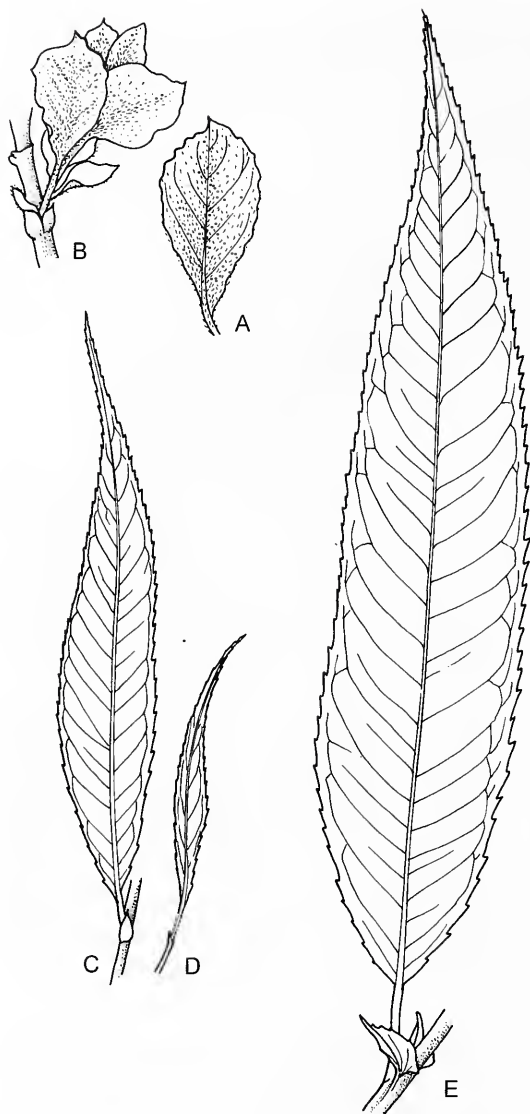


FIGURE 9.—Leaves and stipules of introduced species of *Salix*. A, B, *S. caprea*, Keet STEU13012 (NBG),  $\times 1$ ; C, D, *S. babylonica*, Haugh 517 (NH) & Henderson 671 (NH),  $\times 1$ ; E, *S. fragilis* subsp. *fragilis*, Henderson 786 (PRE),  $\times 1$ . Artist: G. Condy.

Type: Northern Cape, near rivers in mountains near Hantam, *Thunberg* s.n. (UPS22958, lecto., designated here, IDC microfiche 1063/963!).

*S. gariepina* Burch.: 317, t. 6 (1824); Burt Davy: 338 (1921); Von Breitenbach: 73 (1965). *S. capensis* var. *gariepina* (Burch.) Andersson: 13 (1867); Andersson: 197 (1868); Sim: 329 (1907); Skan: 579 (1925); Burt Davy: 432 (1932); Newsholme: 118 (2002). Syntypes: Northern Cape: Prieska District, banks of the Orange River, *Burchell* 1637 (K!) and Orange River, near Petrusville, *Burchell* 2669 (K!).

*S. mucronata* var. *caffra* Burt Davy: 71 (1922). Type: Eastern Cape, Eastern Districts, *Cooper* 48 (PRE!, holo., BM!, K!, iso.).

Tree with dense to sparse drooping crown, up to 10 m tall, occasionally attaining 15–20 m in height, with stem diam. of 300–600 mm; twigs always slender, glabrous, yellow or red. Bark becoming rough, deeply furrowed with age; branchlets terete, slender,  $\pm$  pubescent when

young, quite glabrous, often shining and reddish to dark brown when older; wood white to purplish white, satiny, soft, light and brittle. Leaves thin, becoming leathery, few reddish hairs when young, otherwise glabrous, green on both sides (Figure 8A); summer leaves (30–)40–55 (–75)  $\times$  5–11 mm (Figure 8B), apex acuminate or acute, base cuneate, margin closely or remotely serrulate, rarely entire; petiole glabrous, 2–5(–7) mm long.

In this treatment, subsp. *mucronata* is considered to be the same as subsp. *capensis* and partially as subsp. *mucronata* of Immelman (1987). This view is different from Jordaan (2002a) and Coates Palgrave (2002), where subsp. *mucronata* was applied to the tropical plants and is considered in this treatment as subsp. *subserrata*, because of the correct application of the type of *Salix mucronata* (see elsewhere in this publication). It has the smallest summer leaves of all the subspecies, usually shorter than 55 mm and narrower than 11 mm, and is commonly known as the small-leaved willow.

It is the most widespread wild willow and is found mainly in the drainage basins of the Vaal and Orange Rivers and their tributaries in North-West, Free State, Lesotho, Northern Cape and southern Namibia, and rivers in Western and Eastern Cape as far north as the Umzimkulwana River in KwaZulu-Natal (Figure 10). It occurs on islands or near and on the banks of streams and rivers in bushveld and grassland at altitudes of 600–2 000 m.

Vouchers: Burt Davy 1503 (BOL, PRE); Dieterlen 314A (NH, PRE, SAM); Jacot Guillarmod 7384 (GRA, PRE); McDonald 914 (NBG, PRE); Merxmüller & Giess 2270 (WIND); Van Wyk BSA325 (PRU).

5b. subsp. *hirsuta* (Thunb.) Immelman in *Bothalia* 17: 173 (1987). Type: Cape, *Thunberg* 23038 [UPS, lecto., incorrectly designated by Immelman (1987) as UPS23028, microfiche in PRE!].

*S. hirsuta* Thunb.: 6 (1794); Willd.: 695 (1806); Thunb.: 31 (1823); Skan: 579 (1925); Von Breitenbach: 74 (1965); Palmer & Pitman: 416 (1972); Coates Palgrave: 91 (1977). *S. capensis* var. *hirsuta* (Thunb.) Andersson: 14 (1867); Andersson: 198 (1868); Sim: 329 (1907).

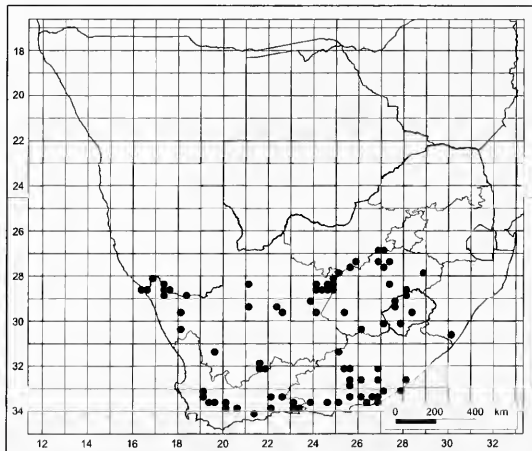


FIGURE 10.—Distribution of *Salix mucronata* subsp. *mucronata* in southern Africa.



Shrub or small tree 2–4 m tall, with yellow winter buds; branches rather stout, densely silver-hirsute. *Bark* smooth, grey; branches at first densely whitish villous, becoming glabrescent, red-brown and somewhat rugose; branchlets angular. *Leaves* oblong to lanceolate, 20–70 × (5–)10–15 mm (Figure 8F, G), apex mucronate, acute or acuminate, base round to cuneate, thinly covered above and densely beneath with grey silky hairs, becoming glabrous, margin entire or sometimes remotely and obscurely serrulate; petiole short, 1–6 mm long, densely hirsute; stipules brown, membranous, obliquely ovate, ± 1.5 mm long, silky-hairy, soon deciduous. *Flowering time*: September to October. *Fruiting time*: October to November.

*S. mucronata* subsp. *hirsuta* is the most easily distinguished subspecies because of its grey silky indumentum on branchlets, stipules and leaves. Commonly known as the silver willow and confined to the Western Cape along the Olifants River and probably the Berg River and their tributaries (Figure 11).

Krauss (1845), Skan (1925) and Adamson (1950) cited the distribution of *S. hirsuta* as the Cape Peninsula, at Hout Bay, Bergvliet and rivulets near Constantia and Stellenbosch. The natural habitat in the Cape Peninsula and surroundings has been largely destroyed and the distribution of subsp. *hirsuta* given by these early authors has raised the suspicion that it might have been much wider until early in the last century or they must have confused these trees with subsp. *mucronata*.

Vouchers: Lewis 3524 (SAM); Marloth 11035 (NBG, PRE); Pillans 9831 (PRE); Van Jaarsveld 4496 (NBG, PRE); Wagener 217 (NBG).

5c. subsp. **woodii** (Seemen) Immelman in Bothalia 17: 176 (1987). Type: Natal [KwaZulu-Natal], Upper Tugela River, near Colenso, Wood 4970 (NH, holo.!).

*S. woodii* Seemen: 53 (1896); J.M.Wood: 121 (1907); Marloth: 130 (1913); Burtt Davy: 339 (1921); Bews: 79 (1921); Skan: 577 (1925); Burtt Davy: 432 (1932); Von Breitenbach: 70 (1965); Jacot Guill.: 161 (1971); Palmer & Pitman: 415 (1972); Compton: 172 (1976).

*S. natalensis* Wimm. ex Andersson: 14 (1867); Andersson: 198 (1868). Type: Natal [KwaZulu-Natal], Port Natal (Herb. Vindob. Guenzius 136).

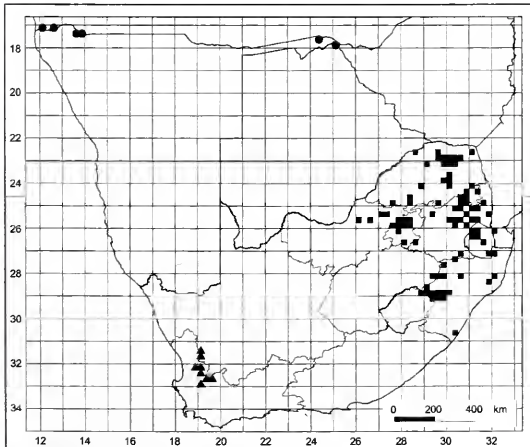


FIGURE 11.—Distribution of *Salix mucronata* subsp. *hirsuta*, ▲; subsp. *subserrata*, ●; and subsp. *woodii*, ■, in southern Africa.

*S. wilmsii* Seemen: 9 (1900); Marloth: 130 (1913); Burtt Davy: 340 (1921); Burtt Davy: 432 (1932). *S. woodii* var. *wilmsii* (Seemen) Skan: 578 (1925). *S. mucronata* Thunb. subsp. *wilmsii* (Seemen) Immelman: 176 (1987), syn. nov. Type: Eastern Transvaal [Mpumalanga], Lydenburg District, Wilms 1350 [PRE, lecto.!, designated by Immelman (1987); BOL, isolecto.].

*S. wilmsii* × *safsaf* Burtt Davy: 432 (1932). Type: Mpumalanga, Lydenburg, Grootfontein River, foot of Burgers Pass, Burtt Davy H1559 (PRE, holo.!). Burtt Davy also cites: Eastern Transvaal [Mpumalanga], Barberton, Pole Evans H2965 (PRE!).

*S. wilmsii* × *woodii* Burtt Davy: 432 (1932). Type: Eastern Transvaal [Mpumalanga], Barberton, Galpin 1278 (GRA!, PRE!).

An arborescent shrub or small tree 2–10 m tall, with long, lax, somewhat drooping branches, much-branched; branches always stout, usually sparsely to densely grey-anescent, rarely puberulous to glabrous. *Bark* dark brown, deeply fissured; young twigs red. *Leaves* narrowly lanceolate, (50–)60–160 × 5–15(–22) mm (Figure 8E), apex long-acuminate, tapering at base, smooth to slightly hairy, pale green above, with greyish bloom below, with dense, grey, silky indumentum, sometimes hairy, becoming glabrescent and glaucescent with age, margin entire or serrulate; petiole 2–14 mm long. *Flowering time*: August to September. *Fruiting time*: October to April. Figure 12.

The width of the summer leaves of this subspecies might overlap with that of the other subspecies but it has the longest leaves, up to 160 mm. Commonly known as the flute willow because suitable lengths of the branches are used for making toy whistles (Smith 1966). Occurs in the drainage basins of the Limpopo, Crocodile, Olifants, Komati, Umbuluzi and Maputo Rivers and adjacent streams in Limpopo, North-West, Gauteng and Mpumalanga, and of the Umbuluzi River in Swaziland. Also in the Tugela and Black and White Umfolozi River basins in the eastern Free State, Lesotho and KwaZulu-Natal (Figure 11).

There are no constant distinguishing characters that separate *S. mucronata* subsp. *woodii* and subsp. *wilmsii* (Coates-Palgrave 1977). Specimens have entire to serrate leaves and the young twigs are all hirsute, becoming glabrous with age. Therefore only one taxon occurs in the eastern parts of the Drakensberg Escarpment in the drainage lines of the rivers that run into the Indian Ocean, from the Umzimkulu in the south to the Komati and Maputo Rivers in the north. The subspecific epithet *woodii* is the oldest name and has therefore been used.

Vouchers: Balkwill & Cadman 2472 (J, PRU); Bayer & McClean 101 (BOL, PRE); Compton 31168 (NBG, NH, PRE); Dieterlen 314B (NH, PRE); Galpin 1278 (BOL, SAM); Theron 3569 (GRA, PRU).

5d. subsp. **subserrata** (Willd.) R.H.Archer & Jordaan in Bothalia 35: 92 (2005). Type: Egypt, near Cairo, Bulak, Herb. Willd. 18137 (B-WILLD, holo., fragm., IDC microfiche 7440-30/1313!).

*S. subserrata* Willd.: 671 (1806); Milne-Redh.: 474 (1936); Meikle: 588 (1958); D.R.Maire: 50 (1961); Von Breitenbach: 70 (1965); Friedr.-Holzh.: 14 (1967); Léonard & Geerincx: 2 (1967); Palmer & Pitman: 413 (1972); Wilmot-Dear: 1 (1985); Meikle: 258 (1989); Wilmot-Dear: 121 (1991).

*S. safsaf* Forssk.: LXXVI (1775) as *S. safsaf baelledi* nom. nud. ex Trautv.: 6, tab. 2 (1836); Andersson: 196 (1868); Boiss.: 1183 (1879);

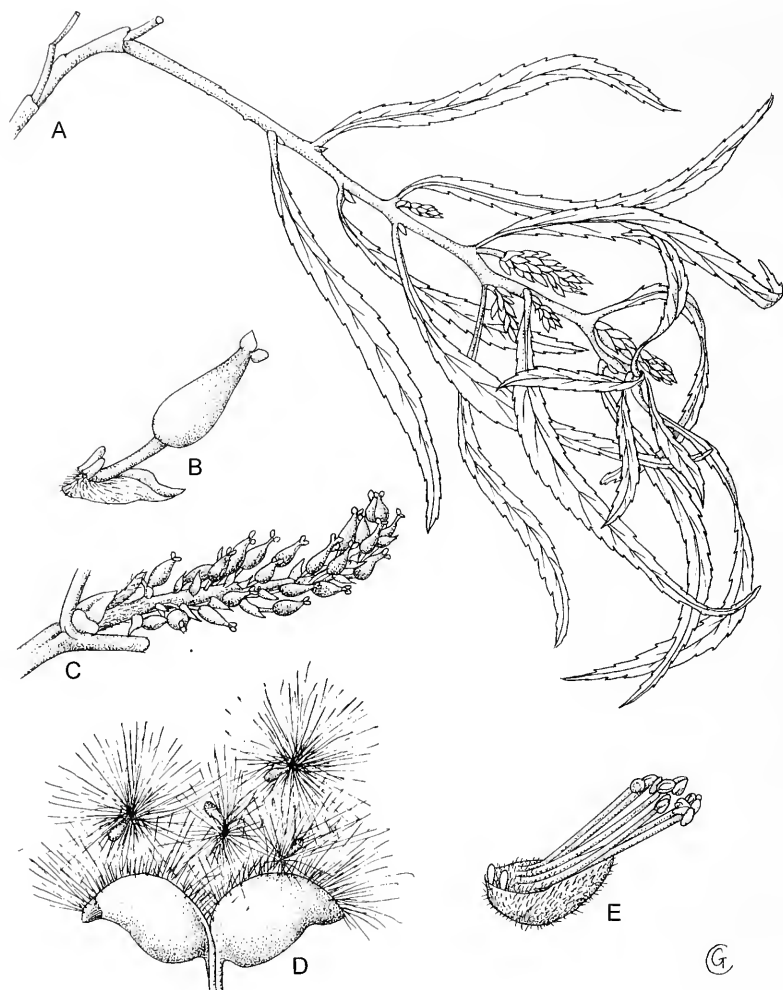


FIGURE 12.—*Salix mucronata* subsp. *woodii*. A, terminal shoot,  $\times 0.9$ ; B, female flower,  $\times 8.8$ ; C, female catkin,  $\times 8.8$ ; D, dehiscent capsule with seeds,  $\times 4.4$ ; E, male flower,  $\times 8.8$ . A, B, C, E, Poynton IH10464; D, Obermeyer TM31027. Artist: G. Condy.

Skan: 318 (1917); Newsholme: 118 (2002). Type: Egypt, *Herb. Sieber* (?LE, holo., K? iso.).

*S. aegyptiaca* sensu Thunb. non Willd.: 30 (1806).

Tree up to 12 m tall; branches drooping, slender or stout, glabrous or with dense grey canescence, becoming glabrous and often reddish with age. *Leaves* broadly lanceolate to elliptic, 40–100(–150)  $\times$  (10–)15–40 mm (Figure 8C, D), apex acute to obtuse, base cuneate, olive-green and glossy above, glaucous below, soon glabrous on both surfaces, margin subentire or denticulate, reticulate venation slightly visible above, hardly visible beneath; petiole slender or stout, 3–15 mm long, glabrous or pubescent. *Flowering time*: early spring. *Fruiting time*: July to December.

*S. mucronata* subsp. *subserrata* has the broadest leaves, up to 40 mm wide, and is widespread in Africa, from North Africa (Egypt and Arabian Peninsula) southwards through tropical Africa to southern Africa in Namibia along the Kunene and Zambezi Rivers and abundant along the Chobe River in Botswana. A widespread tree in fringing bush, on sandy soil along rivers and streams, and on islands in places likely to become inundated for at least part of the year (Figure 11).

Vouchers: Maguire 1707 (NBG); Merxmüller & Giess 30494 (PRE, WIND); Roux 332 (NBG, PRE); Tinley 1493 (WIND); Van Wyk BSA52 (PRE, PRU); Ward, Ward & Seely 10438 (PRE, WIND).

6. *\*Salix babylonica* L., Species plantarum edn 2: 1017 (1753); Andersson: 212 (1868); Boiss.: 1185 (1879); A.Camus & E.-G.Camus: 246 (1904); E.F.Linton: 21 (1913); Britton & Brown: (1913); Burt Davy: 338 (1921); Burt Davy: 81 (1922); M.J.Fischer: 311 (1928); Burt Davy: 431 (1932); Fernald: 506 (1950); D.R.Maire: 57 (1961); A.K.Skvortsov: 28 (1969); Jacot Guill.: 161 (1971); Coates Palgrave: 91 (1977); Meikle: 1488 (1985); Wilmot-Dear: 124 (1991); A.E.van Wyk & P.van Wyk: 154 (1997); L.Hend.: 161 (2001). Type: Orient, Tournemont (*Herb. LINN*1158.20, lecto., designated here, microfiche in PRE!).

A weeping tree up to 10 m tall with long, slender, dense, spreading crown and branches hanging  $\pm$  vertically and reaching the ground; stems yellow-brown, terete, glabrous. *Leaves* narrowly ovate-lanceolate to linear-lanceolate, 60–85  $\times$  8–17 mm, tapering into a long fine acumen (Figure 9C, D), apex asymmetrical, base cuneate, bright green above, glaucous beneath, glabrous, margin regularly serrulate; petiole 3–6 mm long, glabrous or

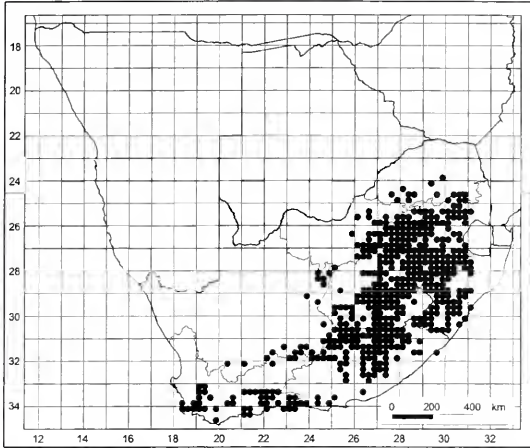


FIGURE 13.—Distribution of *Salix babylonica* in southern Africa, drawn from SAPIA Database, PPRI, 1979–2005.

thinly pubescent; stipules foliaceous, 4–12 mm long, ovate-lanceolate, dentate, caducous. *Inflorescences* on short axillary branches, appearing with the leaves or soon after; bracts ovate-lanceolate, glabrescent, axis, basal part and margins with long white hairs. *Female catkins* 15–25 mm long; female flowers with 1 nectary gland; ovary glabrous, sessile or subsessile; style very short,  $\pm 2$  mm long; stigmas 2-lobed.

The weeping willow was introduced from Europe, but originally came from central and southern China and is planted extensively in southern Africa, along rivers and around dams. It is one of the most widespread invaders of watercourses in South Africa and is particularly abundant in the Grassland Biome, where in places, it forms pure stands along whole river reaches (Henderson 1991a). Only female trees are known to exist in southern Africa (Poynton 1973)—the University of the Free State, Bloemfontein, has one male tree—see Henderson (1991c).

Naturalized in southern Africa since at least the time of Ecklon ( $\pm 1823$ –1832). Now recorded from most of southern Africa where there is permanent water (Figure 13). A widespread weed in many parts of the world, spreading in marshy places and along streambanks by means of branches breaking off and taking root. Place of origin uncertain, probably China. Despite the specific epithet, it does not occur naturally in the Middle East.

Vouchers: Burt Davy 1887 (NH, PRE); Du Preez 1910 (PRU); Gubb KMG10838 (PRE); Henderson 671 (NH, PRE); Jacot Guillarmod 2970 (GRA, PRE); Oliver 3121 (PRE, NBG).

7. \**Salix fragilis* L., Species plantarum edn 2: 1017 (1753); Andersson: 209 (1868); Boiss.: 1184 (1879); A.Camus & E.-G.Camus: 257 (1904); E.F.Linton: 14 (1913); Britton & Brown: (1913); Fernald: 505 (1950); D.R.Maire: 51 (1961); Rech.f.: 45 (1964); Jalas & Suominen: 14 (1976); A.K.Skvortsov & J.R.Edm.: 707 (1982); L.Hend.: 162 (2001). Type: 'Habitat in Europae borealibus' (*Herb. LINN* 1158.19, lecto., designated here, microfiche in PRE!).

#### var. *fragilis*

A robust tree up to 15 m tall, with a broad rounded crown; branches ascending; trunk deeply furrowed. Bark grey; branchlets at first thinly pubescent, becoming glabrous and brittle with age. *Leaves* narrowly lanceolate to slightly rhomboid-lanceolate, 60–160  $\times$  15–40 mm (Figure 9E), acute at both ends, glabrous, dark glossy above, glaucous below, margin coarsely serrulate; petiole 5–15 mm long, with 2 glands at base of leaf; stipules small, sublinear, 4–7 mm long, caducous. *Inflorescences* axillary, short-stalked, appearing with the leaves, drooping; axis hairy; bracts green, covered with many long, silky hairs. *Female catkins* very slender, cylindrical, 60–110 mm long. *Female flowers* with 2 nectaries; ovary sessile or shortly pedicellate, narrowly acuminate, slender; style very short,  $\pm 1$  mm long; stigmas 2-lobed. No male plants found in southern Africa.

Commonly known as the crack or brittle willow and originally from Western Europe. An invasive alien species less widely distributed than *S. babylonica*, but in places forming pure stands along rivers (Henderson 1991a) at high altitudes in Free State, KwaZulu-Natal and Eastern Cape, with one record from the Cape Peninsula (Figure 14).

Vouchers: Compton 21071 (NBG); Fuls 183 (PRE, PRU); Henderson 930 (PRE); Hilliard & Burt 13432 (NU, PRE); Scott 32 (NH); Wolley Dod 2517 (BOL).

8. \**Salix caprea* L., Species plantarum edn 2: 1020 (1753); Andersson: 222 (1868); Boiss.: 1188 (1879); A.Camus & E.-G.Camus: 102 (1905); E.F.Linton: 47 (1913); Britton & Brown: (1913); Fernald: 517 (1950); Rech.f.: 50 (1964); Newsholme: 59 (2002). Type: 'Habitat in Europae siccis' [*Herb. LINN* 1158.88, lecto., designated by Jonsell & Jarvis: 151 (1994)].

Tree up to 6 m or occasionally up to 9 m tall, with spreading branches forming a broad crown; branchlets pubescent, becoming glabrous, reddish or dark brown. Bark grey, fissured. *Leaves* broadly ovate to ovate-oblong, 60–160  $\times$  (8–)20–50(–80) mm (Figure 9A, B),

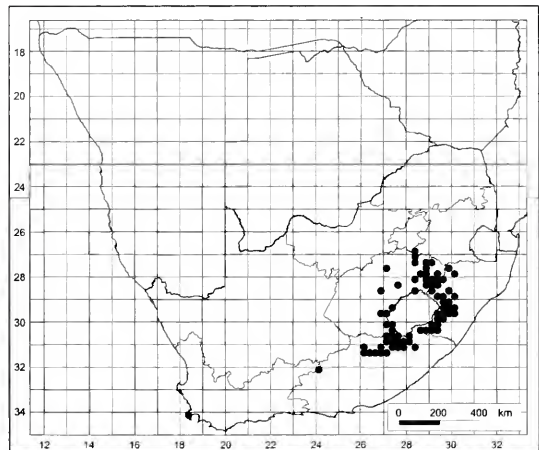


FIGURE 14.—Distribution of *Salix fragilis* var. *fragilis* in southern Africa, drawn from SAPIA Database, PPRI, 1979–2005.



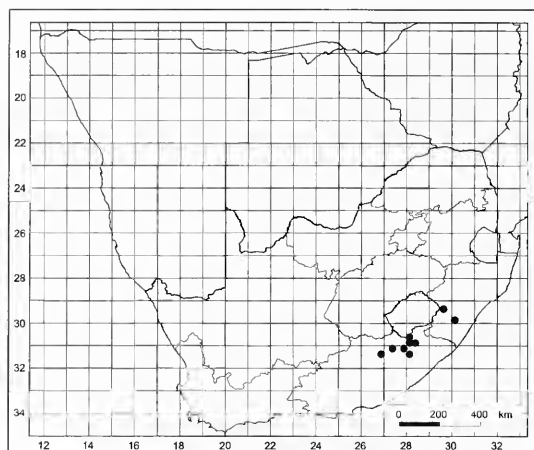


FIGURE 15.—Distribution of *Salix caprea* in southern Africa, drawn from SAPIA Database, PPRI, 1979–2005.

apex acute with a twisted tip, base rounded or cordate, glabrescent and green above, persistently softly pubescent beneath, margin undulate, crenate or entire; petiole up to 6 mm long; stipules semicordate, acuminate, often dentate, persistent. *Inflorescences* axillary, catkins, silky, silver-grey, appearing before leaves in late winter, subsessile; bracts narrowly ovate, subacute, with long silky hairs, brownish below black upper portion. *Male catkins* rather stout, 30–45 × 15–23 mm. *Male flowers*: stamens 2, long-exserted, ± 10 mm long; nectary cylindrical, short. *Female catkins* very slender, 20–30 mm long, cylindrical. *Female flowers*: nectary 1; ovary hairy, pedicellate, pedicel much longer than nectary; style very shorter; stigma small, undivided. *Capsules* ovoid, up to 10 mm long, subsessile on axis. *Seeds* 1.0 × 0.4 mm, cylindrical, with fine vertical ridges, grey.

Commonly known as the goat willow or great willow. It was introduced from Europe and has been recorded as an occasional escape from cultivation in KwaZulu-Natal and the northeastern parts of Eastern Cape (Henderson 1991c) (Figure 15).

Vouchers: Bester 1001 (PRU); Henderson 668, 670 (PRE); Jacobs 8572 (PRE); Keet STEU13012 (NBG); Looek NBG18870 (NBG).

#### SPECIES INSUFFICIENTLY KNOWN

*Salix crateradenia* Seemen: 9 (1900); Skan: 578 (1925). Type: Botswana, *Passarge* 41 of 1896 (not found). From the description and locality this is probably *S. mucronata* subsp. *subserrata*.

*Salix mucronata* var. *integra* Burt Davy: 70 (1922). Type: Eastern Cape, Camdeboo, on the flats and at the river near the Camdebooberg, 2000–3000 ft [615–923 m], *Drège* s.n. (K!, S!). The Stockholm specimen is *S. mucronata* subsp. *mucronata*, but the Kew specimen is subsp. *hirsuta*, with large entire leaves and dense silvery pubescence on the young parts. No other specimen of subsp. *hirsuta* from the Camdeboo has been seen, and neither did Drège collect it at the Olifants River, where subsp. *hirsuta* occurs. It is possible that the Kew specimen has been mislabelled.

*Salix woodii* var. *grandifolia* Burt Davy: 432 (1932) *nom. nud.* Specimens cited: Burt Davy 10614; Legat H4331; Robertson 1474. Burt Davy speculated that this could be a hybrid between *S. woodii* and *S. wilmsii*.

*Salix woodii* × *safsaf*? Burt Davy: 432 (1932). Type: northern Transvaal [Limpopo], Louis Trichardt, 3100 ft [954 m], Rogers 21690 (not found). This is *S. mucronata* subsp. *woodii*.

#### SPECIMENS EXAMINED

Abbott 2696 (5a) PRU. Acocks H828 (5a); 10120 (5c) NH, PRE. Adamson 1002 (5a) BOL, PRE. Archibald 3967 (5a) GRA; 5238 (5a) PRE.

Balkwill & Cadman 2472 (5c) J, PRU. Barker 4828, 6257 (5a) NBG. Barnard SAM36109 (5a) SAM. Bayer 1873 (5c) NH. Bayer & McClean 101 (5c) BOL, PRE. Bayliss BRI.B.87 (5a) GRA, PRE; BRI.B.159, BRI.B.1358 (7) PRE; BRI.B.6160 (6) PRE. Berry KMG13219 (5a) PRE. Biggs 5 (5c) PRE. Bohnen 8896 (5a) NBG. Bolus 468 (5a) BOL; A7767 (5a) GRA. Botha 793, 1447 (5c) PRE, PRU. Botha & Ubbink 1033 (5a) PRE. Boucher 1985 (5b) NBG, PRE; 3509 (7) NBG, PRE. Bourquin 888 (5a) PRE. Brink s.n. (5a) PRE. Britten 2439 (5a) GRA, PRE. Brown 557 (5b) NBG. Buckle 13980 (5c) BOL. Buitendag 616, 997 (5c) NBG, PRE; 1082 (5c) NBG. Burke 330 (5c) BOL. Burrows 3785 (5a) GRA. Burt Davy 605 (5c) PRE; 1266 (5c) BOL; 1503 (5a) BOL, PRE; 1559, 1584 (5c) PRE; 1887 (6) NH, PRE; 5185 (5c) GRA.

Codd 8246, 10095 (5c) PRE. Codd & De Winter 5558 (5c) PRE. Coetzee 600 (6) PRE. Compton 4960, 6913 (5b) NBG; 7405, 18349, 21058 (5a) NBG; 19743 (5c) NBG; 21071 (7) NBG; 27697, 30094 (5c) NBG, PRE; 30731 (5c) NBG, NH; 31168 (5c) NBG, NH, PRE. Cooper 223 (5a) BOL. Culverwell 0183 (5c) PRE.

Devenish 889, 1016, 1464 (5c) PRE. De Winter 7685 (5c) PRE. Dieterlen 314A (5a) NBG, NH, PRE, SAM; 314B (5c) NH, PRE; 6718 (5c) SAM. Dinter 5132 (5a) PRE, SAM. Dlamini s.n. (5c) PRE. Duggan & Henderson 15 (2) PRE; 24 (5c) PRE; 52 (6) PRE. Du Plessis 387 (6) PRE; 427 (1) PRE. Duthie STEU10587, 17701 (5a) NBG.

Ecklon & Zeyher 147 (5a) BOL, NBG. Edwards 2033 (5c) PRE; 2054 (7) PRE; 2059 (5c) PRE. Ellery 267 (5c) PRE. Erasmus KMG12112 (5a) PRE. Esterhuysen 424 (5d) WIND. Eyles 706 (5d) SAM.

Ferrar 1873 (5a) NH. Flanagan 1417 (5a) NBG. Fourcade 3105 (5a) BOL, NBG. Fuls 72 (5a) PRE; 181 (5a) PRU; 183 (7) PRE; 196 (5c) PRE.

Galpin 1278 (5c) BOL, SAM; 7873 (5a) PRE; 9157, 12169 (5c) PRE; BOL13733, BOL21497 (5c) BOL. Geldenhuys 276, 343 (5a) NBG; 344 (5a) NBG, PRE. Gemmell 6474 (5a) PRE. Germishuizen 6093 (5c) PRE. Gerstner 3852 (5c) NH; 5492 (5c) PRE. Gertenbach & Groenewald 9221 (1) PRE. Giess, Volk & Bleissner 5399 (5a) PRE. Gibbs Russell et al. 169 (4) PRE. Giffen 249 (5a) PRE; G940 (5a) GRA. Gillett 1946 (5a) NBG; 2955 (5c) BOL. Gilmore 428 (5c) PRE. Glen 2473, 3092 (5c) NH; 3640 (5a) PRE. Goldblatt 3278 (5b) NBG. Goossens 1144 (5a) PRE. Gubb KMG10755 (3) PRE; KMG10838, KMG10840, KMG11175 (6) PRE; KMG10845, KMG10847, KMG12165 (5a) PRE.

Hafström H961 (5a) PRE. Haugh 517 (6) NH. Hanekom 1272 (5b) NBG, PRE. Hardy 401, 975 (5c) PRE. Hemm 452 (5c) PRE, PRU. Henderson 628, 643, 653 (1) PRE; 595, 679, 794, 906, 996, 1017, 1090, 1102 (2) PRE; 1088 (3) PRE; 989 (5a) PRE; 823 (5c) PRE; 671 (6) NH; 681, 782, 807, 833, 897, 903, 919, 928, 931, 976, 988, 995 (6) PRE; 784, 786, 788, 798, 814, 824, 828, 898, 930, 992, 999, 1004 (7) PRE; 668, 670 (8) PRE. Henrici 3090 (5a) PRE. Herbst 21 (5a) PRU. Herre STEU12072 (5a) NBG; STEU20350 (5d) NBG; STEU24283 (2) NBG. Heson NH26940 (5c) NH. Hilliard & Burt 13257 (5a) NU, PRE; 13432 (7) NU, PRE. Hugo 746 (5b) NBG, PRE. Hutchinson, Forbes & Verdoorn 139 (5c) NH.

Immelman PRE60975 (1) PRE.

Jacobs 8572 (8) PRE. Jacot Guillarmod 2970 (6) PRE; 2972, 2973, 7384 (5a) GRA, PRE; 8691 (5c) GRA. Jarman 22 (1) PRE. Jenkins s.n.

(5b) PRE; JMH8168 (5c) BOL. Jordaen 356, 3528 (2) PRE. Jürgens 22419 (5a) PRE.

Keet 1463, 1567 (5c) NBG; STEU13011 (5a) NBG; STEU13012 (8) NBG; STEU13015, STEU24285 (2) NBG. Killick 510 (6) PRE; 4309 (7) PRE; 4383 (5a) PRE. Killick & Marais 2130 (5c) PRE. Kinges 1797 (6) PRE. Kluge 48 (2) NBG; 888 (1) PRE. Krynauw 281 (5c) PRE.

Leendert: 4272 (5c) PRE. Legat 161 (5c) PRE. Leistner 1342 (5a) PRE. Leistner et al. 110 (5d) PRE. Le Roux & Ramsey 219 (5a) NBG, PRU; 811 (5a) NBG, PRE. Letty 483 (5c) PRE. Lewis 1511 (5c) SAM; 2922 (5a) SAM; 3534 (5b) SAM. Long 769 (5a) PRE. Look NBG18870 (8) NBG. Louw 1467 (5a) PRE.

MacMurry 1659 (5c) PRE. MacOwan 1645 (5a) SAM. Maguire 1707 (5d) NBG; 1974 (5a) NBG. Marais 343 (7) PRE. Marloth 817, 6188 (5a) NBG; 11035 (5b) PRE, NBG; 11493 (5b) NBG; 8941, 11843, 12387 (5a) NBG, PRE. McDonald 914 (5a) NBG, PRE. Merxmueller & Giess 2270 (5a) PRE, WIND; 3661 (5a) PRE; 30494 (5d) PRE, WIND. Metelerkamp 380 (5a) BOL. Meyer 987 (5c) PRE. Middlemost 1733 (5b) NBG; 2168 (5a) NBG. Moffett 627 (6) NBG, PRE. Mogg 7543, 14134, 19529, 37129 (5c) PRE. Moll 5278 (5c) NH; 5290 (5c) NH, PRE. Muir 3857 (6) PRE. Muller 1099 (5a) PRE. Munro s.n. (5c) PRE.

Noel RU11610 (5a) GRA.

Oates 319 (5a) PRE. Obermeyer 576, TM31027 (5c) PRE. Oliver s.n. (5b) NBG; 3121 (6) NBG, PRE. STE30264 (5a) NBG. Olivier 1432 (2) NBG. Onderstall 1173, 1346 (5c) PRE. Örtendahl 294 (5a) PRE.

Pearson 3111, 3255 (5a) SAM. Pegler 529, 937 (5a) BOL, PRE. Penzhorn 5805 (5a) PRE. Phillips MOSSI323 (5b) PRE; 1403 (5a) PRE. Pillans 5101 (5a) BOL; 9831 (5b) PRE. Player 70 (5c) PRE. Powrie 107 (5a) PRE. Poynton 17889 (5a) PRE. Pringle 14790 (5a) PRE. Prior 33 (5c) PRE. Prosser 1036 (5c) PRE.

Ramsay 1600 (5a) GRA. Range 595, 1551 (5a) SAM. Rattray 121 (5a) PRE. Rehmann 6509 (5c) BOL, NBG. Repton 3485 (5c) PRE. Retief & Herman 114 (5c) PRE. Roberts STEU17438 (2) NBG. Rodger 3858 (6) GRA. Rodin 3687 (5a) BOL, PRE. Rogers 2736 (5c) BOL, GRA; TM4759, TM4834 (5c) BOL, PRE. Ross 2032 (5c) NH. Roux 332 (5d) NBG, PRE; 1212 (5a) NBG; 1231 (5c) NBG, PRE. Rudatis 1243 (5c) NBG.

Salisbury 443 (5a) GRA. Scharf 1491 (5a) PRE. Scheepers 1196 (5c) PRE. Schelpe 8121 (5a) BOL. Schlechter 3938 (5c) BOL; 9016, 9017 (5a) NBG, PRE. Schmitz 8844, 9355 (7) PRE. Scott 32 (7) NH. Shearing 79, 654 (5a) PRE. Sim 1 (7) PRE; 1503 (5a) PRE. Smith 6054 (5c) PRE. Smook 7268 (5a) PRE; 7317 (7) PRE; 8023 (5a) PRE. Smuts PRE51969 (5c) PRE. Smuts & Pole Evans 857 (5c) NBG, PRE. Stayt 5 (5c) PRE. Steynberg 714 (5c) PRE. Strey 5866 (5a) NH; 7695 (6) NH; 10995 (5c) NH, PRE. Sutton 295 (5a), 907 (5c) PRE.

Taylor 370, 557 (5a) NBG, PRE; 11799 (5b) NBG. Teague 125 (5d) SAM. Theron 1249, 1312 (5a) PRE; 1402 (5c) PRE, PRU; 3569 (5c) GRA, PRU. Thode 8175 (5c) NBG. Thompson 1545 (5b) NBG, PRE. Thorcroft 586 (5c) NH; 2150, 3007 (5c) PRE. Tinley 1493 (5d) WIND. Trauseld 623 (5c) PRE; 818 (6) PRE. Troughton 226 (5a) PRE. Tyson 2504 (5a) SAM.

Ubbink 988 (5c) PRE.

Van der Merwe 29 (6) PRE. Van der Schijff 51, 357, 812, 4750 (5c) PRE, PRU. Van der Westhuizen 44/78 (5a) NBG, PRE; 97/80 (5a) NBG. Van Graan & Hardy 459 (5c) PRE. Van Jaarsveld 2410, 2411 (5b) NBG; 2596 (5a) NBG, PRE; 2640, 2647, 2651, 2711 (5a) NBG; 4496 (5b) NBG, PRE; 4621, 5741, 6853A (5a) NBG. Van Jaarsveld & Bean 5788 (5a) NBG, PRE. Van Jaarsveld, Forrester & Jacobs 8448 (5a) NBG. Van Rensburg 27 (6) PRE. Van Wyk 1843 (5a) PRU. Van Wyk BSA52 (5d) PRE, PRU; BSA3102 (5d) PRU; 169 (6) PRE. Van Wyk & Kok 5781 (5a) PRE. Van Wyk, Retief & Herman 6737 (5a) PRE. Venier 8124 (5a) PRE; 11834 (5c) PRE. Viviers 903 (5a) NBG.

Wagener 217 (5b) NBG. Walgate BOL33831 (5a) BOL. Ward 2224 (5c) GRA; 2225 (5c) NH. Ward, Ward & Seely 10438 (5d) PRE, WIND. West 496 (5c) PRE; 1329 (7) PRE. Westphal TM25 (5c) PRE. Wilman 2600 (5a) BOL. Wilms 1350 (5c) BOL, PRE. Wolley Dod 2517 (7) BOL. Wood 6669 (5c) NH; 9769 (5c) SAM.

Zambatis 169 (4) PRE; 1028 (5c) PRE. Zietsman & Zietsman 1247 (5a) PRE.

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## Three new species and a new synonym in *Strumaria* (Amaryllidaceae: Amaryllideae) from southern Africa

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**Keywords:** Amaryllidaceae, Amaryllideae, key, new rare species, southern Africa, *Strumaria* Jacq.

### ABSTRACT

Newly described are three species of *Strumaria* Jacq. subgenus *Strumaria*. *S. prolifera* Snijman from the Kourkammaberg in Namaqualand, South Africa, is a rare species closely allied to *S. barbarae* Oberm. *S. speciosa* Snijman from the Sonberg, southern Namibia and *S. luteoloba* Snijman from Namuskluft, southern Namibia and the Richtersveld in Northern Cape, South Africa, are rare species closely related to *S. phonolithica* Dinter. *S. gigantea* D.Müll.-Doblies & U.Müll.-Doblies is formally presented as a new synonym of *S. phonolithica*. A key to the species in *Strumaria* subgenus *Strumaria* is given.

### INTRODUCTION

*Strumaria* Jacq., a genus belonging to the tribe Amaryllideae subtribe Strumariinae is endemic to the semi-arid areas of southern Africa. Most species are found in the winter rainfall region, whereas only two taxa extend into the summer rainfall karroid areas. Among southern African Amaryllidaceae, *Strumaria* is second only to *Cyrtanthus* Aiton (tribe Cyrtantheae) in terms of the natural rarity of individual species, and as many as 80% of *Strumaria* species have been assessed as rare and threatened (Snijman & Victor 2002).

When last revised, *Strumaria* encompassed 25 species (Snijman 1994), unlike the earlier classification of Müller-Doblies & Müller-Doblies (1985), which presented the group as comprising four small genera: *Strumaria sensu stricto*, *Gemmaria* Salisb., *Bokkeveldia* D.Müll.-Doblies & U.Müll.-Doblies, and *Tedingea* D.Müll.-Doblies & U.Müll.-Doblies. The results of a recent phylogenetic study of the Amaryllideae, using morphology and molecular data from internal transcribed spacer (ITS) sequences (Meerow & Snijman 2001), however, have supported the broad classification of *Strumaria* by Snijman (1994), which recognizes subgenus *Strumaria*, subgenus *Gemmaria* and subgenus *Tedingea*.

More recently, several new collections from underexplored areas of Namaqualand and southern Namibia have come to hand. Some of these were found to represent undescribed species that are described here for the first time. In addition, *S. gigantea* D.Müll.-Doblies & U.Müll.-Doblies, which was published after *Strumaria* was last revised in 1994, is formally presented as a new synonym of *S. phonolithica* Dinter.

*Strumaria phonolithica* and the three new species all belong to subgenus *Strumaria*, bringing the number of species in the subgenus to eight. Like other members of

subgenus *Strumaria* they have strap-shaped, glabrous leaves, dorsifixed anthers and a persistent infructescence. Other features that are not consistently present in all representatives of the subgenus, but which help to characterise the group, are the three or more leaves arranged in a spreading fan, a sheathing cataphyll, and the apparently tubular to hypocrateriform or campanulate flowers. In addition, the pedicels often approximate the length of the flowers and the filaments are mostly fused into a basal tube divided into three nectar wells. A key to the eight species currently placed in subgenus *Strumaria* is given.

***Strumaria prolifera* Snijman, sp. nov., ex affinitate *S. barbarae* Oberm., sed bulbo prolifero, foliis oppositis et humo patentibus, perigonio 18–20 mm difert. Figura 1.**

**TYPE.**—Northern Cape, 2917 (Springbok): Kourkammaberg, (–CD), 11-7-1989, Bruyns 3883 (NBG, holo.; K. PRE).

Deciduous, bulbous herb, 120–200 mm tall in flower. *Bulbs* clumped, producing bulblets, subglobose,  $\pm$  25 diam.; outer tunics pale brown, parchment-like; neck slender, up to 20 mm long. *Leaves* emerging with inflorescence, distichous, 2 or 3, suberect to recurved at first, spreading flat on ground when mature, narrowly lanceolate, 80–180  $\times$  4–8 mm, plane, thin-textured, pale green, glabrous; apex subacute; outermost 2 leaves sheathing at base; cataphyll not exerted above ground; seedlings glabrous. *Inflorescence* 2–4-flowered, unilaterally clustered, 15–30 mm across; scape more or less erect, roundish in cross section, 120–200  $\times$  2 mm, pale pink to pale green, glabrous, withering but remaining attached to bulb when dry; spathe valves 2, narrowly lanceolate, 10–20  $\times$  3 mm, pink, becoming papery and spreading, persistent; bracteoles linear,  $\pm$  5 mm long; pedicels lax and pendulous at anthesis, 6–15  $\times$  1 mm, pale pink to pale green. *Perigone* actinomorphic, funnel-shaped, 10–15 mm wide at mouth, delicate shell-pink, drooping, faintly narcissus-scented, collapsing and turning dark pink when old; tepals 6, free to base, both whorls adnate to staminal tube for  $\pm$  1 mm,

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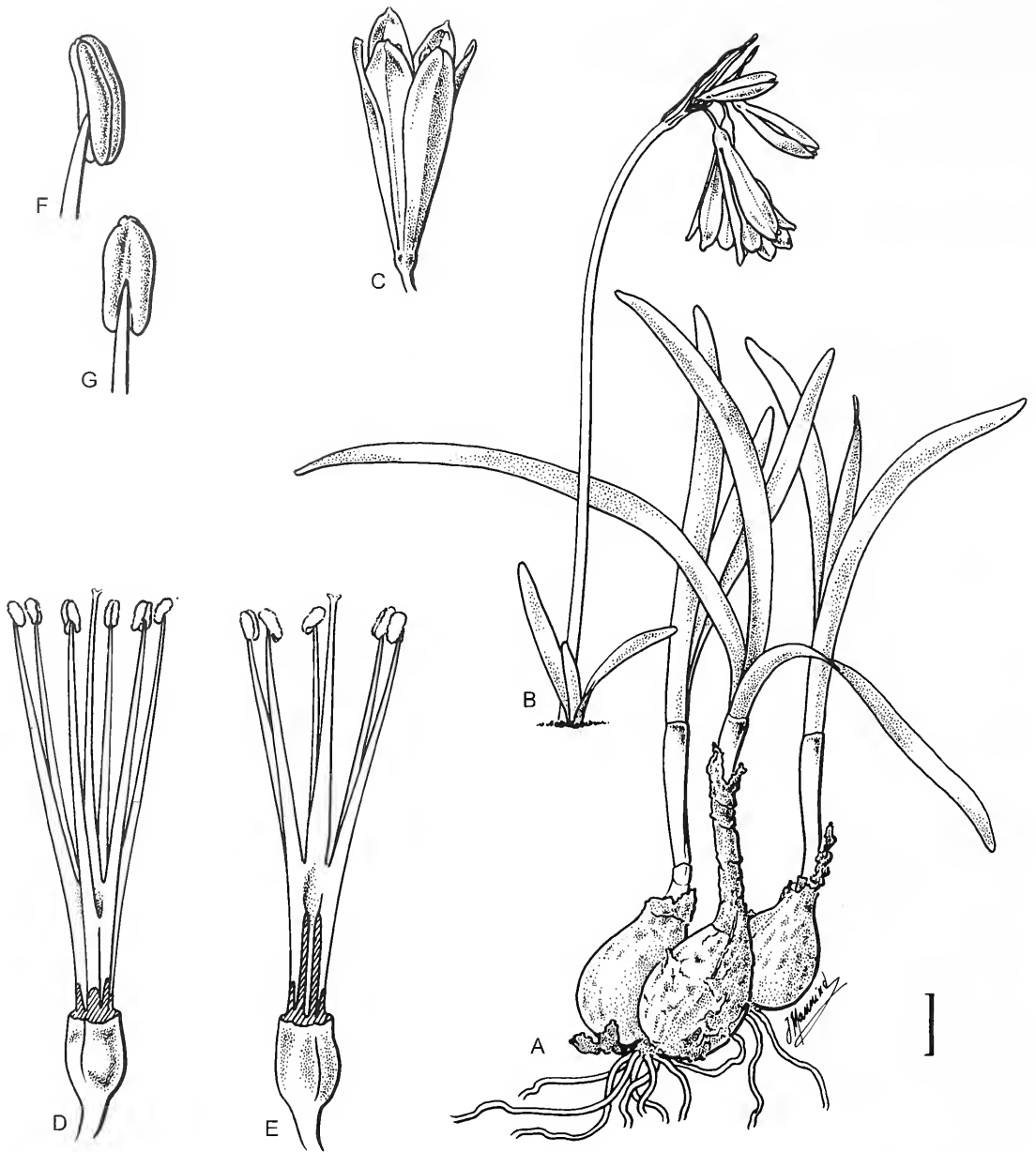


FIGURE 1.—*Strumaria prolifera*: A, clumped bulbs and young leaves; B, inflorescence; C, whole flower; D, flower with tepals removed; E, one inner stamen removed showing fusion of outer stamens with style; F, anther, lateral view; G, anther, dorsal view. Scale bar: A, B, 8.25 mm; C, 6 mm; D, E, 3 mm; F, G, 1 mm. Drawn from Bruyns 3883. Artist: John Manning.

oblanceolate, 18–20 × 4.0–4.5 mm, narrowing to 1.5 mm at base, spreading slightly. *Stamens* 6, slightly shorter than tepals, spreading distally; filaments ± 15 mm long, connate proximally into a 3–5 mm long tube, outer whorl proximally adnate to 3-winged style for ± 3 mm, inner whorl free from style forming ± 3 mm deep nectar wells; anthers dorsifixed, 2 mm long and cream-coloured before opening; pollen pale lemon-coloured. *Ovary* ovoidal, 2–3 mm diam., trilocular with 2 ovules per locule, pinkish green; nectaries septal; style 14 mm long, slightly shorter than stamens, ± 3-winged proximally; stigma trifid, papillate. *Capsule* papery, small,

dehiscing loculicidally. *Seeds* green, fleshy, ± 5 mm diam.; embryo green.

*Phenology*: in cultivation, *S. prolifera* flowers simultaneously with the bulb's newly emerging leaves in the middle of May. Several attempts have been made to study the species flowering in nature, but despite visits to the Kourkammaberg over three consecutive years in late April and May, the species has not been seen flowering in the wild. This may suggest that the bulbs flower infrequently in nature, possibly only after good autumn rains. The soft, delicate leaves



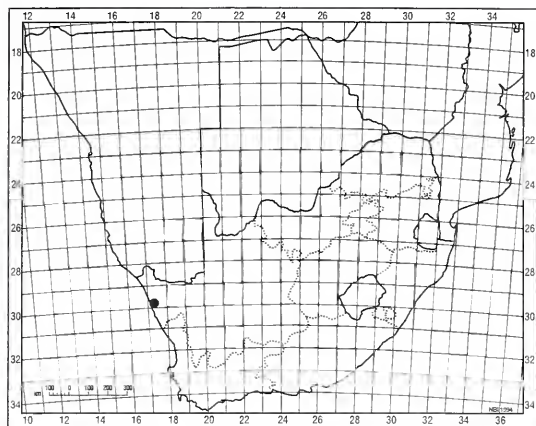


FIGURE 2.—Known distribution of *Strumaria prolifera*.

remain green throughout winter but die off with the onset of hot, dry summer conditions at the end of spring.

**Diagnostic features:** *Strumaria prolifera* is easily recognized by its pink, funnel-shaped flowers, which enclose the stamens. Only two other species have similarly shaped flowers with short, included stamens, namely *S. barbarae* Oberm. from southern Namibia and the eastern Richtersveld, and *S. pubescens* W.F.Barker from the Roggeveld escarpment and Laingsburg District. Based on the stamen and style morphology, *S. prolifera* shows greatest affinity with *S. barbarae*, which belongs to subgenus *Strumaria*. In both species the filaments form a proximal tube up to 3–5 mm long and through the fusion of the outer stamens to the three-winged style base, the tube is divided into three separate hollows, where nectar collects from the peristylar pores on the ovary dome (Figure 1E). Thus insects seeking nectar are forced to probe each hollow consecutively. Moreover, both species have drooping, scented flowers. The perigone in *S. barbarae*, however, is longer (28–38 mm) and mostly white when fresh, unlike the shorter (18–20 mm long), distinctly pink perigone in *S. prolifera*. More divergent is *S. pubescens*, belonging to subgenus *Gemmaria*, that has spreading to erect flowers in which all six stamens are adnate to the narrowly trigonous style base. Nectar therefore discharges and collects as three small droplets in the sinuses between the inner filaments and style.

A noteworthy feature is that all the species belonging to subgenus *Strumaria* (*S. bidentata* Schinz, *S. barbarae*, *S. hardyana* D.Müll.-Doblies & U.Müll.-Doblies, *S. luteoloba* Snijman, *S. phonolithica*, *S. speciosa* Snijman and *S. truncata* Jacq.), except *S. prolifera*, have erect to falcate leaves arranged in a single fan. *Strumaria prolifera* is unique in the subgenus in having straight, soft, opposite leaves, which ultimately spread flat on the ground. The species is furthermore distinguished by the formation of bulblets and extremely thin-textured, pale green leaves.

**Distribution and habitat:** *Strumaria prolifera* is known only from the Kourkammaberg, an isolated, predominantly quartzite mountain on the coastal forelands

of Namaqualand (Figure 2). The bulbs grow on southern slopes near the mountain's summit, where they are confined to partial shade between large rocks (*P. Desmet pers. comm.*). The population consists of highly localized colonies of up to 100 plants. Low succulent shrubs dominate the surrounding vegetation.

**Etymology:** the species is named *prolifera* for its characteristic proliferation by offsets, which slowly give rise to dense colonies of bulbs and apparently compensate for the bulbs' infrequent flowering and fruiting.

***Strumaria speciosa* Snijman, sp. nov., *S. phonolithicae* Dinter affinis, sed floribus nutantibus, pedicellis 30–50 mm longis, perigonio campanulato et staminibus  $\pm 10$  mm exsertis differt. Figure 3.**

**TYPE.**—Namibia, 2817 (Vioolsdrif): Sonberg, E of Lorelei and Rosh Pinah. (–AA), 7-7-1997, Brynns 7233 (NBG, holo.; PRE, WIND).

Deciduous, bulbous herb, 230–330 mm tall in flower. *Bulbs* clumped, subglobose, 30–35 mm diam.; outer tunics tough and pale brown; neck stout, 10–15 mm across, reaching up to 100 mm above ground. *Leaves* emerging at flowering, 4–6, erect to falcate, arranged in a single plane, broadly lorate, 90–150  $\times$  17–25 mm, plane, pale green, glabrous; apex subacute; cataphyll unknown. *Inflorescence* 11–14-flowered, widely and evenly spreading, 80–110 mm across; scape straight, recurved at apex during anthesis, becoming erect in fruit, 260–400  $\times$  3.0–4.5 mm, pale green, glaucous, withering and collapsing after fruiting; spathe valves 2, lanceolate, 15–28  $\times$  2–6 mm, papery, spreading, pale pink, persistent; bracteoles linear, up to 15 mm long; pedicels firm, mostly straight, curved downwards at apex when flowering but completely straight when fruiting, 30–50  $\times$  1.5 mm, pale green. *Perigone* actinomorphic, campanulate and  $\pm 11$  mm across in lower half, recurved above, nodding, pure white, honey-scented; tepals 6, free to base, linear-oblong, 11–12  $\times$  2 mm, narrowing to 0.5 mm at base, closely imbricate in lower half, channelled, strongly reflexed about midway along their length, outer whorl reflexing  $\pm 1$  mm below inner whorl. *Stamens* 6, well exserted, slightly spreading; filaments 15–18 mm long, connate proximally into a tube,  $\pm 2$  mm long, outer whorl fused to 3-winged style base for  $\pm 3$  mm, inner whorl free from style, forming  $\pm 2$  mm deep nectar wells; anthers dorsifixed,  $\pm 3$  mm long and maroon before opening; pollen cream-coloured. *Ovary* ovoidal,  $\pm 3$  mm diam., trilocular with 3–5 ovules per locule; nectaries septal; style  $\pm 19$  mm long, slightly longer than stamens, 3-winged in proximal third, slender and columnar distally; stigma trifid, papillate. *Capsule* small, papery,  $\pm 7.5$  mm diam., dehiscent loculicidally. *Seeds* green, fleshy,  $\pm 5$  mm across.

**Phenology:** in cultivation the species flowers in the middle of May when the new leaves are present. The leaves remain green during winter and die back sometime in late spring at the end of the rainfall season. As yet, the species has not been recorded flowering in nature.

**Diagnostic features:** in its vegetative state, *Strumaria speciosa* is almost indistinguishable from the southern

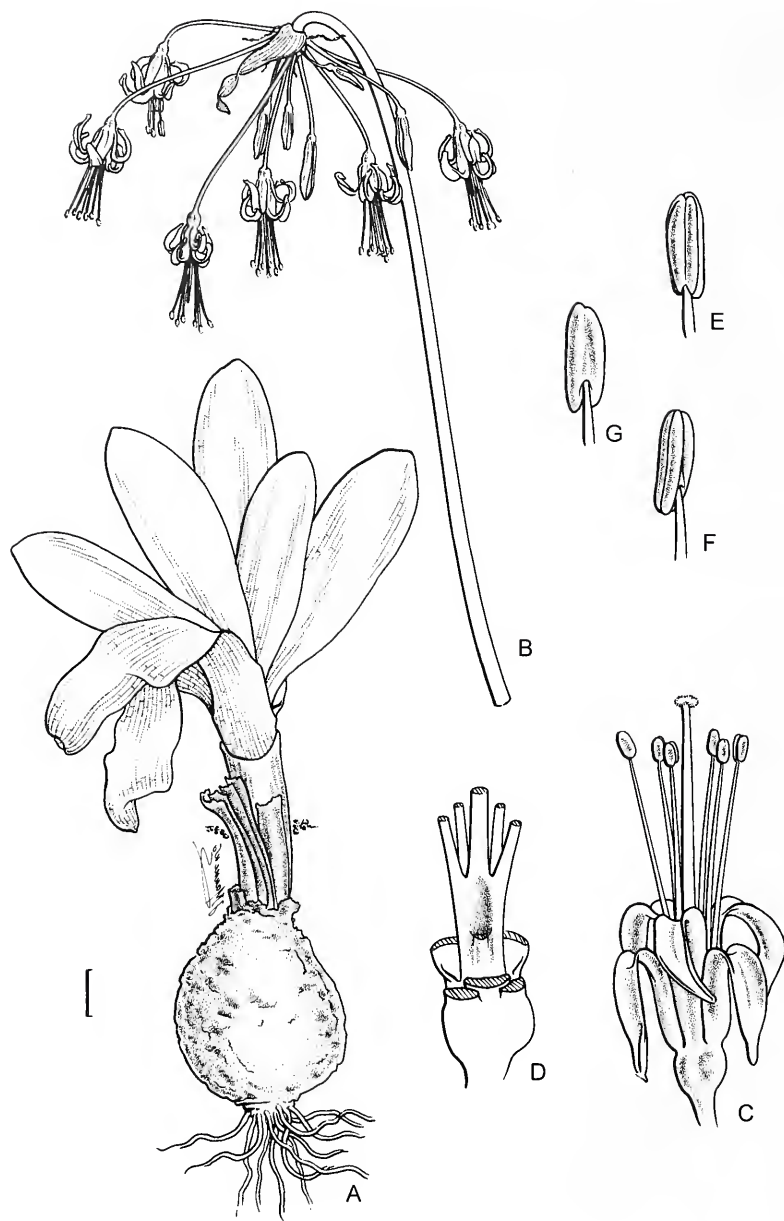


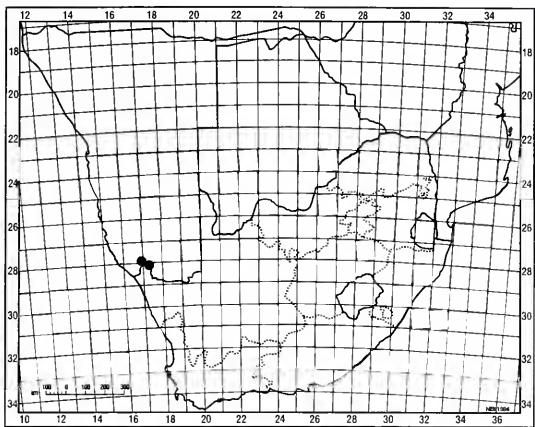
FIGURE 3.—*Strumaria speciosa*: A, bulb and new leaves; B, inflorescence; C, whole flower; D, flower with tepals and one inner stamen removed showing fusion of outer stamens with style. E–G, anther: E, ventral view; F, lateral view; G, dorsal view. Scale bar: A, B, 8.25 mm; C, 3 mm; D, 1.5 mm; E–G, 1.5 mm. Drawn from Bruyns 7233. Artist: John Manning.

Namibian endemic, *S. phonolithica* Dinter. Both species have a stout bulb neck that extends well above ground level (up to 100 mm long in *S. speciosa* and 160 mm long in *S. phonolithica*). The leaves are broad, 17–25 mm wide in *S. speciosa* and 12–50 mm wide in *S. phonolithica*, and they curve laterally to form an outspread, erect fan which is arranged in a single plane. *S. speciosa*, however, is easily distinguished when flowering. The scape is recurved apically and the 30–50 mm long pedicels are firm, outspread and straight, but deflexed distally so that the campanulate flowers are nodding. Furthermore, the tepals are strongly recurved in the distal half so that the stamens protrude by almost 10 mm. In contrast, the firm, outspread pedicels in *S. phonolithica* never exceed 25 mm long so that the flower cluster remains compact. The tepals also remain imbricate for about three-quarters of their length and only recurve

near the tips, thus only the tips of the stamens protrude from the perigone throat. Although *S. phonolithica* and *S. speciosa* are easily distinguished, their strong morphological similarities, nevertheless, emphasize a close alliance.

**Distribution and habitat:** *Strumaria speciosa* is known from only two collections on the Sonberg, a mountain range in the semi-arid, winter rainfall region of southern Namibia (Figure 4). The small, localized populations are found on south-facing slopes below dolomite outcrops at about 900 m. The bulbs grow in soft, loamy soil among stones and low, predominantly succulent shrubs (P.V. Bruyns pers. comm.).

**Etymology:** this new species is named *speciosa* since its splendid head of flowers is unrivalled in the genus.

FIGURE 4.—Known distribution of *Strumaria speciosa*.

#### Other specimen examined

NAMIBIA.—2716 (Witputz): Sonberg, (–DD), 3-9-2001, *Bruyns 8856* (NBG).

***Strumaria luteoloba* Snijman, sp. nov.**, speciei subgeneris *Strumariae* affinis, sed tepalis angustis canaliculatis biseriatis roseis et citrinis, filis libris differt. Figura 5.

**TYPE.**—Namibia, 2716 (Witputz): Namuskluft just SE of Rosh Pinah, (–DD), collecting date unknown, *Lavranos s.n.* (NBG167717, holo.; PRE, WIND).

Deciduous, bulbous herb, 180–280 mm tall in flower. *Bulb* solitary, subglobose,  $\pm 17.5$  mm diam., tunics parchment-like, brown; neck of short, loose, dry, broken tunics. *Leaves* emerging shortly after flowering, 2 or 3(4), erect to slightly falcate, outermost sheathing at base,  $\pm$  arranged in a single plane,  $25\text{--}40 \times 4\text{--}9$  mm, oblong, glabrous, dark green, glaucous or shiny; apex  $\pm$  obtuse; cataphyll unknown. *Inflorescence* 4–7-flowered; secund, drooping, slightly spreading, 30–40 mm across; scape  $\pm$  straight, recurved near apex while flowering,  $200\text{--}280 \times 1.5\text{--}2.0$  mm, glaucous, green, withering and collapsing after fruiting; spathe valves 2, narrowly lanceolate,  $15\text{--}20 \times 2\text{--}3$  mm, papery, parchment-coloured, tinged with pink, spreading, persistent; bracteoles few, linear, up to 9 mm long; pedicels lax, straight to slightly curved,  $8\text{--}25 \times 1$  mm, green. *Perigone* actinomorphic, narrow and rose-pink in lower half,  $\pm 2.5$  mm across, recurved and pale lemon- to cream-coloured above, nodding, becoming increasingly pink with age, heavily scented of fresh coriander; tepals 6, free to base, linear-oblong,  $16\text{--}19 \times 1.5\text{--}2.0$  mm, narrowing to 1 mm at base, imbricate in lower half, strongly recurved and channelled in distal half, outer whorl curving backwards 2–4 mm before inner whorl. *Stamens* 6, well exerted, slightly spreading; filaments  $22\text{--}25$  mm long, free to base, free from style, outer and inner approximately equally long at anthesis; anthers dorsifixed,  $\pm 3$  mm long and maroon before opening; pollen whitish. *Ovary* ovoidal,  $\pm 3$  mm diam., trilocular with 4 or 5 ovules per locule; nectaries septal; style up to 28 mm long, slightly exceeding stamens, slender throughout; stigma trifid, inner surface papillate. *Capsule* unknown. *Seeds* unknown.

**Phenology:** in cultivation the bulbs flower in May, before the new leaves appear. The leaves emerge shortly after flowering and remain green throughout winter until September, when they die back and the bulbs become dormant over the hot, dry summer.

**Diagnostic features:** the erect, fan-shaped leaf arrangement and dorsifixed anthers of *S. luteoloba* are sufficiently distinctive to place the species in subgenus *Strumaria*, but unlike most species in the subgenus, the filaments of *S. luteoloba* are not proximally fused into a tube. Like *S. phonolithica* the new species has narrow, closely imbricate tepals. However, *S. luteoloba* is easily recognized by the tepals being deeply channelled and sharply reflexed from  $\pm$  halfway along their length, and by the outer tepal whorl reflexing 2–4 mm below the inner whorl so that the perigone has a distinctive biseri-ate appearance. The flower colour is also unique in the genus. The perigone is pinkish red near the base and pale lemon- to cream-coloured in the distal half. *S. gemmata* Ker Gawl., belonging to subgenus *Gemmata*, is the only other species with lemon- or cream-coloured flowers but these are stellate and concolorous.

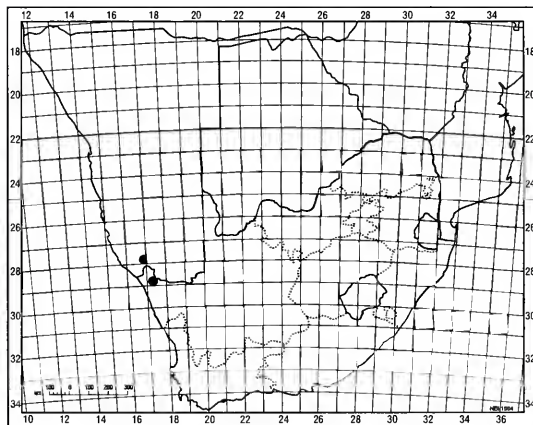
**Distribution and habitat:** *Strumaria luteoloba* is known only from the winter rainfall region of southern Namibia and the Richtersveld, South Africa (Figure 6). At Namuskluft, southern Namibia the plants are found in dolomite-derived soil, whereas the only other known population is on the Rooiberg (D. Hannon pers. comm.), a granite mountain massif in the Richtersveld.

#### Other specimen examined

NORTHERN CAPE.—2817 (Violsdrif): Richtersveld, Rooiberg, about 6 km NE of Eksteenfontein, (–CD), collecting date unknown, *Lavranos s.n.* (NBG barcode 0197778, picture only).

#### A new synonym

Described in 1994, *S. gigantea* was distinguished from *S. phonolithica* by several quantitative characters: the width of the leaves, the number of flowers per inflorescence, the length of the perigone and the size of the unopened anthers (Müller-Doblies & Müller-Doblies

FIGURE 6.—Known distribution of *Strumaria luteoloba*.

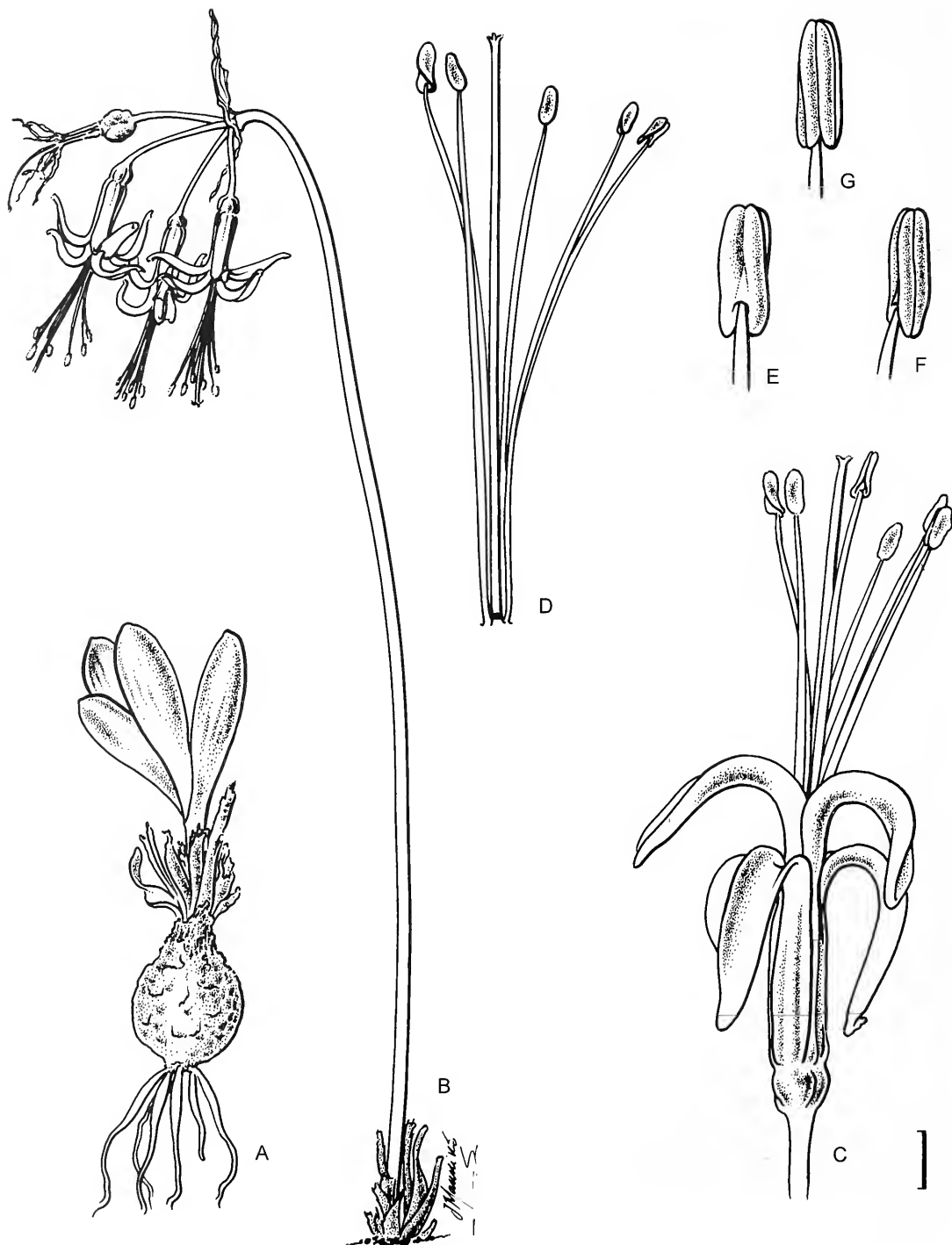


FIGURE 5.—*Strumaria luteoloba*: A, bulb and mature leaves; B, inflorescence; C, whole flower; D, one inner stamen removed showing that outer stamens are free from style. E–G, anther: E, dorsal view; F, lateral view; G, ventral view. Scale bar: A, B, 8.25 mm; C, D, 2.5 mm; E–G, 1.5 mm. Drawn from Lavranos s.n. (NBG167717). Artist: John Manning.



TABLE 1.—Diagnostic features of *Strumaria* plants from the Klinghardt and Aurus Mountains, southern Namibia

	<i>S. phonolithica</i> *	<i>Bruyns 3081</i> +	<i>S. gigantea</i> *	<i>S. phonolithica</i> †
Leaf arrangement	Fan-shaped	Fan-shaped	Fan-shaped	Fan-shaped
Maximum leaf width	12–28 mm	23–26 mm	27–50 mm	12–50 mm
Flower form	hypocrateriform	hypocrateriform	hypocrateriform	Hypocrateriform
Flowers per inflorescence	2–6	8	7–16	2–16
Perigone length	28–36 mm	35 mm	45–55 mm	28–55 mm
Unopened anther length	3.0–3.7 mm	3.0 mm	4.0–6.5 mm	3.0–6.5 mm
Distribution	Klinghardt Mtn	Aurus Mtn	Aurus Mtn	Klinghardt & Aurus Mtns

\* Data for *S. phonolithica* and *S. gigantea* given by Müller-Doblies & Müller-Doblies (1994).  
+ Data for *Bruyns 3081* (NBG) not referred to by Müller-Doblies & Müller-Doblies (1994).  
† Data for *S. phonolithica* as amplified in this study.

1994). In all other respects, however, the two species were regarded as the same, being distinguished from all other *Strumaria* species by their flowers, in which the tepals remain erect and overlapping for most of their length, and only recurve near the apex. When *S. gigantea* was first described, the two species were considered to be allopatric, each being known from a separate inselberg in southern Namibia. *Strumaria gigantea* was described from the Aurus Mountains (Müller-Doblies & Müller-Doblies 1994), whereas *S. phonolithica* was described from the Klinghardt Mountains (Dinter 1923), ± 60 km to the northwest. In the apparent absence of intermediate material, *S. gigantea* was thus separated from *S. phonolithica* on size alone. However, Müller-Doblies & Müller-Doblies overlooked a specimen at NBG (*Bruyns 3081*), collected on the Aurus Mountains in 1988, which indicates that the two taxa overlap geographically and intergrade morphologically. *Strumaria gigantea* is thus formally placed into synonymy under *S. phonolithica* based on the data given in Table 1.

***Strumaria phonolithica* Dinter** in Feddes Repertorium 19: 178 (1923). Type: Klinghardtgebirge, Aug. 1922, *Dinter s.n.* (B, lecto.), designated by Müller-Doblies & Müller-Doblies (1985).

*Strumaria gigantea* D.Müll.-Doblies & U.Müll.-Doblies: 346 (1994). Type: Namibia, Aurus Mountains, 18-9-1988, *Müller-Doblies 88144c* (WIND, holo.; B, BOL, BR, BTU, K, M, MO, PRE, S, STE), not yet deposited at BOL, PRE, STE, WIND; syn. nov.

Key to species of *Strumaria* subgenus *Strumaria*

- 1a Flowers ascending; tepals less than 8 mm long; style broad in lower half, abruptly narrowed into a slender column above ..... *S. bidentata*
- 1b Flowers pendulous to spreading, rarely ascending; tepals longer than 8 mm; style at most 3-angled below but slender throughout:
  - 2a Tepals linear-oblong, less than 5 mm wide, channelled and strongly recurved in upper parts:
    - 3a Tepals closely imbricate for at least two thirds of their length, recurved towards their tips; stamens exerted from perigone throat for less than a quarter of their length ..... *S. phonolithica*
    - 3b Tepals closely imbricate in lower half, recurved in upper half; stamens exerted from perigone throat for ± half their length:

- 4a Perigone narrow and rose pink in lower half, ± 2.5 mm across at throat; tepals pale lemon- to cream-coloured above at anthesis ..... *S. luteoloba*
- 4b Perigone slightly expanded in lower half, ± 11 mm across at throat; tepals usually pure white at anthesis ..... *S. speciosa*
- 2b Tepals oblanceolate, more than 5 mm wide, ± plane, erect to spreading, not strongly recurved:
  - 5a Stamens included in perigone at anthesis, shorter than tepals by 3 mm or more:
    - 6a Leaves firm and shiny green; perigone more than 25 mm long, white at anthesis, flushing delicate pink when old ..... *S. barbarae*
    - 6b Leaves soft and pale green; perigone less than 25 mm long, shell pink at anthesis, turning dark pink when old ..... *S. prolifera*
  - 5b Stamens exerted from perigone at anthesis, exceeding tepals by up to 3 mm or more:
    - 7a Leaves plane or slightly undulate, margin hyaline, apex emarginate; cataphyll subterranean ..... *S. hardyana*
    - 7b Leaves twisted or rarely plane, apex entire; cataphyll reddened and exerted above ground ..... *S. truncata*

ACKNOWLEDGEMENTS

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# Lamarck's new species of Mesembryanthemaceae and the types of their names

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**Keywords:** Lamarck Herbarium, Mesembryanthemaceae, new names, nomenclatural changes, types

## ABSTRACT

The holotype of *Mesembryanthemum echinatum* Lam. is an unpublished, sketchy drawing kept in the Lamarck herbarium (P-LAM). The holotype of the name *M. vaginatum* Lam., which has not been taken up again since its original publication, is also in P-LAM. That name has priority over *M. ciliatum* Aiton, pertaining to a species currently placed in *Brownanthus*. Two new combinations are proposed: *Brownanthus vaginatus* (Lam.) Chesselet & M.Pignal and *Brownanthus vaginatus* subsp. *schenckii* (Schinz) Chesselet & M.Pignal.

## INTRODUCTION

The French naturalist Jean Baptiste de Monnet de Lamarck (1744–1829) established the first evolutionary synthesis of modern biology and participated in the great debates about living species and evolution of life that took place in late 18th century Europe (Corsi 2001). Lamarck's interests covered diverse topics including botany, chemistry, meteorology, and notably zoology, where he made the fundamental distinction between vertebrates and invertebrates, his contribution to botany is voluminous. In the *Flore française* (1779), Lamarck used the principle of dichotomous sorting for the identification of all taxa, thereby enabling identification to species level, a technique now widely used by botanists. In the *Encyclopédie méthodique*, he described numerous new species, but in the Mesembryanthemaceae only two. These are the topic of this contribution.

The *Encyclopédie méthodique*, published between 1783 and 1808, comprises eight volumes plus supplements. The two first volumes, and the third up to the letter P, are entirely the work of Lamarck. Many of the plants described there correspond to specimens kept in the Lamarck Herbarium (P-LAM). This valuable historic collection is rich in types and comprises  $\pm 19\,000$  specimens. An Internet site dedicated to the works and contributions of Lamarck ([www.lamarck.net](http://www.lamarck.net)) provides digitized images of the first 7 000 specimens, and the others too, are being made progressively available there and through the SONNERAT database (<http://www.mnhn.fr/base/sonnerat.html>). The Lamarck herbarium changed hands several times: it was sold, towards the end of Lamarck's life, to the German Botanist Johannes Roepert (the first to use floral diagrams), then bought by the University of Rostock in Germany and finally acquired, in 1886, by the Muséum of Paris. The collection is now housed not far from its origin in the house of Buffon

where Lamarck had his office at the Jardin des Plantes (Aymonin 1980, 1981).

Lamarck, in the section on Ficoïde, described two new mesemb species in the *Encyclopédie* (1788: 478): *Mesembryanthemum echinatum* Lam., a distinctive species, and the oldest name in the genus *Delosperma* N.E.Br., and *Mesembryanthemum vaginatum* Lam. the first validly published name that applies to a species currently in the genus *Brownanthus* Schwantes.

## *Mesembryanthemum echinatum* Lam.

In the case of *M. echinatum*, a mix-up due to the re-assembly of the Lamarck collection has engendered confusion. In addition to being moved several times, the Lamarck herbarium was included into and later separated from the general herbarium at Rostock (the latter process taking no less than five years: see Aymonin 1981). Lamarck did not wish specimens to be glued as he preferred to observe the plants from all angles. His original herbarium consisted of unmounted specimens of dried plants with loose labels in species covers. They were mounted subsequently when Edmond Bonnet, curator of the herbarium at the Muséum, was given the task of re-arranging the Lamarck collection in 1900. Bonnet first had the specimens attached with paper strips and, for its arrangement, adopted the order of Durant (that largely follows the system of Bentham and Hooker). Lamarck preferred an arrangement that reflected natural relationships to an alphabetical system such as that of Linnaeus. The consequences of keeping the plants unmounted would not have been too serious had the herbarium been kept in Paris, such as those of the Jussieu (P-JU), acquired by the Muséum in 1857 after the death of Adrien de Jussieu, and that of Michel Adanson (1727–1806), donated to the Paris herbarium in 1924. Fixing of specimens of the Jussieu herbarium with pins and strips is thought to have taken place in the mid-19th century but the fixing of specimens with sticky strips took place much later in the history of this herbarium.

The name *Mesembryanthemum echinatum* was published by Lamarck (1788) where the species was described and qualified as v.v. (*vu vivant*, or *vidi vivum*), to

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MS. received: 2004-10-26.

indicate that the description was based on live material grown at the Jardin des Plantes. The species, currently in *Delosperma* N.E.Br., has been the subject of past debate (Taylor & Eggli 1986). The combination in *Delosperma* was made by Schwantes (1927) who gave the basionym as '*M. echinatum* Ait.' (Aiton 1789). However, Lamarck's name was published one year earlier in 1788 [not 1786 as stated by Taylor & Eggli (1986), see Stafleu & Cowan (1979)]. In his book on succulent plants, Candolle (1799) suggested that the material from which Lamarck's description was made, originated from the

Cape of Good Hope and was brought to Britain by Francis Masson in 1774, from where it came to the Jardin des Plantes. It is possible that Aiton's concept of *M. echinatum* was based on material of the same origin as Lamarck's plant, although this cannot be shown unequivocally.

What was still a debatable issue in 1986 has since been clarified by a new provision in the ICBN (Greuter *et al.* 2000, Art. 33.6(a)): even though Schwantes, in publishing the combination *Delosperma echinatum*, refer-



FIGURE 1.—Herbarium sheet from the Lamarck Herbarium of *Mesembryanthemum scabrum* showing appended description and drawing of *Delosperma* (*Mesembryanthemum*) *echinatum*.



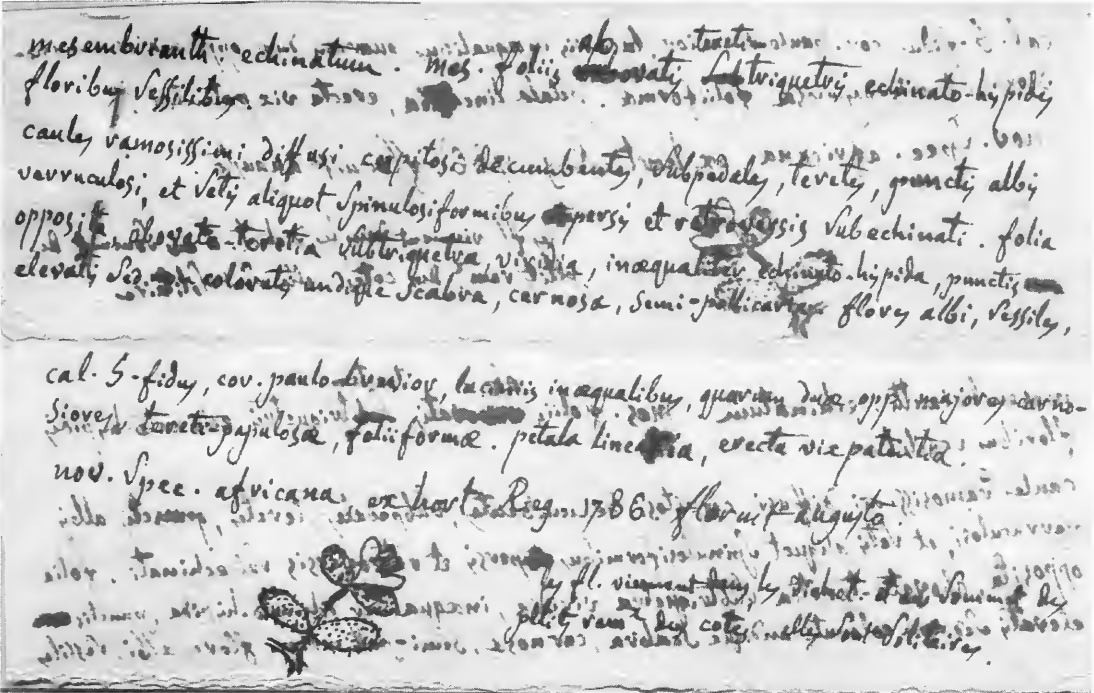


FIGURE 2.—Holotype of *Mesembryanthemum echinatum* Lam. including description and sketch. 'mesembrianth. echinatum floribus sessilibus, mes. foliis obovatis, tereti-triquetris, echinato-hispidis. Caules ramosissimi diffusi caespitose decumbentes, subpedales, teretes, punctis albis verruculosi, et setis aliquot spinulosiformibus aspersi et retroversis subechinati. folia opposita, obovato-teretia subtriquetra, viridia, inaequaliter echinato-hispida, punctis elevatis sed non coloratis undique scabra, carnosae, semi-pollicariae. flores albi sessiles, cal. 5-fidus, cor. paulo brevior, laciniis inaequalibus, quarum duae opp. majores carnosiores, tereti-papillose, foliiformae. petala linearia, erecta vix patentia. nov. spec. africana, ex hort. Reg. 1786. floruit auguste. fl. videntur long. 1.25 cm. et au sommet des petits ram. des cotés. Elles sont solitaires.' Translates as: 'Mesembryanthemum echinatum with sessile flowers. Mesembryanthemum with leaves obovate, terete-triquetrous, echinate-hispid. Stems highly branched diffuse caespitose decumbent, of about 1 foot long [30 cm] terete, subechinate white verruculose dots, and sometimes setae spinulose, rugose sparse reflexed. Leaves opposite, obovate-terete almost triquetrous green, unequally echinate-hispid with elevated dots but not coloured everywhere, scabrid, fleshy, half an inch long [1.25 cm]. Flowers white, sessile, calyx 5-partite, a little shorter than the corolla, the lobes unequal of which two opposite ones are longer and fleshy, terete papillose and leaf-shaped. Petals linear, erect, hardly spreading. New African species from the royal garden. 1786, Flowered in August. The flowers come in the dichots and at the summit of small branches on the sides. They are solitary.'

red to the wrong basionym author, Aiton; and even though Aiton did not mention Lamarck's earlier validation of *Mesembryanthemum echinatum*, of which he may have been unaware; still Lamarck is to be considered as the basionym author, and the correct author citation for the combination in *Delosperma* is *D. echinatum* (Lam.) Schwantes.

As no original specimens of *M. echinatum* are extant, Taylor & Eggli (1986) designated a photograph of Schwantes (1927) as neotype, and this neotypification was accepted by Hartmann (2001a). However, an original element is extant in the Lamarck herbarium, an illustration which (in the absence of a preserved specimen of the living plant) must be accepted as the holotype. Therefore, the designated neotype has no standing.

Although Taylor & Eggli (1986) consulted a microfiche of the herbarium sheet represented in Figure 1, they failed to realize the true significance of the relevant slip of paper (Figure 2). What Taylor & Eggli (1986) interpreted as a misidentification is in fact the result of the complex history of Lamarck's herbarium. When the collection was finally pasted to herbarium sheets, a small

piece of paper with the description and sketch of *M. echinatum*, by Lamarck, became associated with the wrong herbarium specimen, of *Lampranthus scaber* (L.) N.E.Br. (= *Mesembryanthemum scabrum* L.) (Figure 1). It is possible that the word *scabra* in the description of *M. echinatum* prompted the association of the note with that specimen.

Lamarck's slip obviously dates back to the time when the protologue was written. Along with the description, it includes a sketch of the plant itself, which is original material for the name as defined in the ICBN (Art. 9 Note 2). Although very simple, this illustration agrees with *D. echinatum* as currently understood, a highly distinctive mesemb with echinate leaves and sessile flowers, unique and atypical in the genus as pointed out by Koutnik & O'Connor-Fenton (1985). As no other original material is known to exist, we consider Lamarck's original sketch of *M. echinatum* as the holotype of the name (Figure 2). The associated description begins with the phrase-name provided by Lamarck in the protologue. It reads: '*Mesembryanthemum echinatum. Mesembryanthemum foliis obovatis tereti-triquetris verruculosis echinato-hispidis, floribus sessilibus*'. The type illus-



FIGURE 3.—Holotype of *Mesembryanthemum vaginatum* Lam.

tration, in the Lamarck herbarium in Paris (P-LAM), is attached to the specimen of *M. scabrum* bar-coded as P00307737.

### *Mesembryanthemum vaginatum* Lam.

The second new mesemb species described by Lamarck (1788) is *Mesembryanthemum vaginatum*, with the accompanying phrase-name: '*Mesembryanthemum foliis oppositis basi connato-vaginantibus, vaginis persistentibus crebris inferne barbatis, floribus corymbosis*'. This validating diagnosis is followed by the indication '(v.s.)' [*vu sec*, or *vidi siccum*], meaning that herbarium material was available for study. The corresponding specimen in P-LAM (Figure 3) was brought to Paris from the Cape of Good Hope by Pierre Sonnerat, the French naturalist and draughtsman who visited the Cape in the late 18th century, but is known for his work on the Seychelles, India, the East Indies and China (Gunn & Codd 1981). His specimens were mainly presented to Jussieu and Lamarck, in Paris.

The specimen held in the Lamarck herbarium (P-LAM, bar code P00307735) is considered to be the holotype of *M. vaginatum* Lam. The re-discovery of this type specimen has nomenclatural implications. In modern literature the species represented by that type is known as

*Brownanthus ciliatus* (Aiton) Schwantes, with the basionym, *M. ciliatum*, validated by Aiton (Gerbaulet & Pierce in Hartmann 2001a). Aiton lists the 'Ciliated Fig Marigold' in *Hortus kewensis* (1789) with the phrase-name: '*M. foliis oppositis connatis semiteretibus, stipulis membranaceis reflexis laceris ciliiformibus*'. Aiton's material was introduced to Britain by Francis Masson in 1774. A drawing by Masson (BM) has been designated by Gerbaulet & Pierce (in Hartmann 2001a) as the lectotype of the name *M. ciliatum*. In De Candolle's (1828) treatment of the 'Ficoideæ', *M. ciliatum* Aiton is cited under *species non satis notæ*.

There is a second, later *Mesembryanthemum vaginatum*, by Haworth (1803), which in the original volume of *Index kewensis* is unaccountably treated as if it were but a mere later re-use of *M. vaginatum* Lam. In reality, it is an independent, illegitimate later homonym that belongs to a completely different species. In De Candolle (1828), *Mesembryanthemum vaginatum* Haw. is correctly listed among the taxa currently placed in the genus *Ruschia* Schwantes, with a reference to 'Haw. misc. 95. syn. 284. excl. var.  $\beta$  rev. 127. non. Lam.'. It bears the legitimate name *Ruschia vaginata* Schwantes (with priority dating from 1927, not 1789: see ICBN Art. 58). The neotype designation by Hartmann (2001b) is effective for both *Mesembryanthemum vaginatum* Haw. and the homotypic *Ruschia vaginata* Schwantes.

Lamarck's name is not accounted for elsewhere in De Candolle's work, and is now utterly forgotten. We have considered the option of submitting a proposal to conserve the name *M. ciliatum* Aiton against it, in the interest of stability of botanical nomenclature. We are, however, discarding that option and proposing a name change for nomenclatural reasons. Although the continued use of the name *Brownanthus ciliatus* (Aiton) Schwantes may be preferred for practical reasons, it is not proposed here as the species is little known, unimportant in horticultural trade, only occurs in Northern and Western Cape, and the name is scantily used in the literature. The application of the rule of priority requires the following nomenclatural changes:

***Brownanthus vaginatus* (Lam.) Chesselet & M.Pignal, comb. nov.**

*Mesembryanthemum vaginatum* Lam.: 478 (1788). Type: *Sonnerat s.n.* (P-LAM!, holo. P00307735). *M. ciliatum* Aiton: 179 (1789). *Trichocyclus ciliatus* (Aiton) N.E.Br.: 151 (1923). *Brownanthus ciliatus* (Aiton) Schwantes: 21 (1927). *Psilocaulon ciliatum* (Aiton) Friedrich: 216 (1968).

***Brownanthus vaginatus* subsp. *schenckii* (Schinz) Chesselet & M.Pignal, comb. nov.**

*Mesembryanthemum schenckii* Schinz: 80 (1897). *Trichocyclus simplex* N.E.Br. ex Maass: 234 (1928). *T. schenckii* (Schinz) Dinter & Schwantes ex Range: 18 (1934). *Brownanthus simplex* (N.E.Br. ex Maass) Bullock: 494 (1937). *B. ciliatus* subsp. *schenckii* (Schinz) Ihlenf. & Bittrich: 316 (1985). *B. schenckii* (Schinz) Schwantes: 21 (1927). Lectotype: (following Gerbaulet & Pierce in Hartmann 2001a) *Schenck 174* (K).

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# Cape plants: corrections and additions to the flora. 1

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**Keywords:** Cape Floristic Region, floristics, phytogeography, plant diversity, southern Africa, speciation

## ABSTRACT

Comprising an area of  $\pm 90\,000\text{ km}^2$ , less than 5% of the land surface of the southern African subcontinent, the Cape Floristic Region (CFR) is one of the world's richest areas for plant species diversity. A recent synoptic flora for the Region has established a new base line for an accurate assessment of the flora. Here we document corrections and additions to the flora at family, genus and species ranks. As treated in *Cape plants*, which was completed in 1999, the flora comprised 173 families (five endemic), 988 genera (160 endemic: 16.2%), and 9 004 species (6 192 endemic: 68.8%). Just four years later, a revised count resulting from changes in the circumscriptions of families and genera, and the discovery of new species or range extensions of species, yields an estimate of 172 families (four endemic), 992 genera (162 endemic: 16.3%) and 9 086 species (6 226: 68.5% endemic). Of these, 948 genera and 8 971 species are seed plants. The number of species packed into so small an area is remarkable for the temperate zone and compares favourably with species richness for areas of comparable size in the wet tropics. The degree of endemism is also remarkable for a continental area. An unusual family composition includes, in descending order of size, based on species number, Asteraceae, Fabaceae, Iridaceae, Ericaceae, Aizoaceae, Scrophulariaceae, Proteaceae, Restionaceae, Rutaceae, and Orchidaceae. Disproportionate radiation has resulted in 59.1% of the species falling in the 10 largest families and 74.6% in the largest 20 families. Thirteen genera have more than 100 species and the 20 largest genera contribute some 31.5% of the total species number.

## INTRODUCTION

Published in September 2000, *Cape plants* (Goldblatt & Manning 2000) is a synoptic account of the vascular plant flora of the Cape Floristic Region (CFR) of southern Africa. As with such endeavours, it contained its share of errors and omissions. Moreover, changes to the systematics of plant taxa of the Cape flora have accumulated at a steady pace. Thus, despite our best efforts to produce an accurate and lasting account, we find after just four years since publication, and about five years since completed copy was handed to the publisher, that a fair number of corrections and additions are necessary. Most of these concern species: 9 004 species were recognized in 2000, and we now include 9 086 species in the flora region. Some 988 genera were recognized in the flora in 2000, but with additions and taxonomic changes there are now 992 genera. We hope to continue to publish lists of additions periodically when such compilations seem useful. Changes to the account are discussed in detail below under the headings *Families*, *Genera*, and *Species*.

**Families.** Changes in familial classification, resulting from the continuing molecular research in angiosperm phylogeny, have compelled adjustments to the generic constitution of several families [Angiosperm Phylogeny Group (APG) 1998, 2002]. The rule of priority has also made necessary some name changes. Most notable for the CFR is the work of Olmstead and his collaborators in the Lamiales–Scrophulariales which has shown that *Veronica* L. and its allies, previously Scrophulariaceae, should be included in an expanded Plantaginaceae (Olmstead *et al.* 2001). In the Cape flora the genera affected include *Limosella* L. (two spp.) and *Ilysanthes* Raf. (one sp.),

which are accordingly transferred to Plantaginaceae. These studies also show that several African genera of Scrophulariaceae and Loganiaceae comprise a clade with the Cape family Stilbaceae. In order to retain monophyletic family circumscriptions, these genera have been transferred to Stilbaceae (alternatively Stilbaceae and several more families would have to be included in Scrophulariaceae). Thus *Halleria* L. (three spp.) and *Ixianthes* Benth. (one sp.) are removed to Stilbaceae, which ceases to be endemic to the CFR. *Nuxia* Comm. ex Lam. (previously Loganiaceae) also belongs in an expanded Stilbaceae while *Buddleja* L., previously Loganiaceae and more recently Buddlejaceae, is now included in Scrophulariaceae. This leaves Scrophulariaceae with 31 genera and 409 species, and Loganiaceae with one genus (*Strychnos* L.) and two species in the CFR.

Another important familial change is the union of the endemic southern African family Achariaceae with Kiggelariaceae (Savolainen *et al.* 2000). The conserved name Achariaceae is used for the expanded family. The endemic Cape tree *Hyaenanche* Lamb. & Vahl (one sp.) is now known to be nested in Picrodendraceae (= Pseudanthaceae) (Savolainen *et al.* 2000) and is transferred to this family from Euphorbiaceae. The status of the monotypic *Curtisia* Aiton, usually included in Cornaceae, has varied with time. Molecular data show that the genus is sister to the Cape endemic family, Grubbiaceae, and recognition of a monogeneric Curtisiaceae is recommended by APG (2003). The family Cornaceae is thus no longer represented in the Cape flora. In the monocots, the South African and near Cape endemic, Prioniaceae (with the monotypic *Pronium* E.Mey.) is sister to the South American *Thurnia* Hook.f. and has been referred to Thurniaceae by Chase *et al.* (2000). Tamaricaceae, represented by one species of *Tamarix* L. in the Cape flora, was omitted in error from *Cape plants*.

Convallariaceae, the family that includes *Dracaena* L., *Eriospermum* Jacq. ex Willd. and *Sansevieria* Thunb.,

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must now be known by the earlier name, Ruscaceae. The APG (2003) recommend that Ruscaceae as well as Anthericaceae and Hyacinthaceae be included in an enlarged monophyletic Asparagaceae. They also favour union of Agapanthaceae and Amaryllidaceae in Alliaceae and Asphodelaceae and Hemerocallidaceae in Xanthorrhoeaceae. Alternative treatment is permitted and for the present we do not follow these recommendations and maintain the narrower family circumscriptions in *Cape plants*.

Another family realignment is the inclusion of *Centella* L. in Apiaceae (Araliaceae in *Cape plants*) as a result of extensive molecular study (Lowry *et al.* 2004). Also likely as a result of sequence studies, is the removal of *Ceraria* H. Pearson & Stephens and *Portulacaria* Jacq. from Portulacaceae to Didieriaceae. This previously endemic family of Madagascar forms a sister clade with Portulacaceae *s.s.* (Applequist & Wallace 2001). The changes involving Portulacaceae have not yet been formalized in the literature (APG 2003), and are not taken into account here.

At family level it is most notable that the flora loses its second largest endemic family, Stilbaceae, which in its expanded circumscription extends through tropical Africa and Madagascar to Arabia (*Halleria*, *Nuxia*). This leaves only four endemic families in the CFR: Penaeaceae in Myrtales (21 species), Grubbiaceae in Cornales (three species), Roridulaceae in Ericales (two species), and Geissolomataceae in Saxifragales (one species) (classification following APG 2003). Based on a molecular clock calibrated using 135 mya for the divergence of the eudicot lineage (Savolainen *et al.* 2000; Wikström *et al.* 2001; V. Savolainen unpubl. ms), Penaeaceae may have diverged 20 mya from its sister clade, the African Oliniaceae plus the Neotropical Alzateaceae, whereas Roridulaceae diverged from Ericaceae, its closest relative (Savolainen *et al.* 2000),  $\pm$  48 mya. Geissolomataceae appears to be older, having diverged perhaps 55 mya from Ixerbaceae plus Strasburgeraceae. Grubbiaceae may have diverged from Curtisiaceae in the early Tertiary, 63 mya.

Bruniaceae, one of the distinctive families of the Cape flora, has an estimated 64 species in 11 genera (Goldblatt & Manning 2000). Just three species in two genera extend outside the confines of the Cape Region, two locally, and one as far east as southern KwaZulu-Natal. Bruniaceae may be the sister group to the order Dipsacales (Savolainen *et al.* 2000), perhaps meriting recognition at ordinal rank. The discovery of pollen matching modern Bruniaceae in early Tertiary and late Cretaceous (?Senonian) deposits in northern Namaqualand (S.E. de Villiers pers. comm.), well to the north of the CFR, attests to considerable age for the family in southern Africa. The pollen record also accords with a preliminary early Tertiary dating of the divergence between Bruniaceae and Dipsacales at about 57 mya (V. Savolainen unpubl. ms.). In the later APG (2003) classification, however, Bruniaceae are not assigned to any order in the Euasterids II group.

With the above changes, there are now 149 families of seed plants, and 23 families of ferns and other vascular

cryptogams, for a total of 172 families of vascular plants in the CFR. This is one less than was recognized in *Cape plants*. Anticipated transfer of two genera of Portulacaceae to Didieriaceae would bring the total number of seed plant families to 150. The CFR is characterized by an unusual family composition that includes, in descending order of size (species number) following Asteraceae and Fabaceae, the families Iridaceae, Ericaceae, Aizoaceae, Scrophulariaceae, Proteaceae, Restionaceae, Rutaceae, and Orchidaceae, among the 10 most species-rich families in the flora. Asteraceae alone, with 1 048 species, contributes 11.5% of the total species in the flora. Disproportionate radiation in the 20 largest families (Table 1) has resulted in over 59% of the species falling in the 10 largest families and more than 74% in the largest 20 families.

TABLE 1.—Ranking of the 20 largest families in the Cape flora as indicated by species number from Goldblatt & Manning (2000, 2002a) combined with changes in this paper. These families contribute 7 022 species to the flora, or 75% of the total 9 087 species. Family circumscriptions reflect the recommendations of the Angiosperm Phylogeny Group (1998, 2003)

Family	Total species	No. endemic (% of total)	Total genera (endemic)	Species/genus
1. Asteraceae	1048	653 (62.3)	123 (31)	8.5
2. Fabaceae	761	624 (82.0)	37 (6)	20.6
3. Iridaceae	684	539 (78.8)	32 (6)	21.4
4. Ericaceae	667	644 (96.5)	1 (0)	667
5. Aizoaceae	658	520 (79.0)	77 (19)	8.5
6. Scrophulariaceae	409	294 (71.9)	31 (7)	13.2
7. Proteaceae	330	319 (96.7)	14 (9)	23.6
8. Restionaceae	320	295 (92.1)	19 (10)	16.8
9. Rutaceae	273	257 (94.1)	15 (6)	18.2
10. Orchidaceae	227	138 (60.8)	25 (2)	9.1
11. Poaceae	208	80 (38.5)	61 (3)	3.4
12. Cyperaceae	206	101 (49.0)	29 (3)	7.1
13. Hyacinthaceae	193	89 (41.5)	10 (1)	19.3
14. Campanulaceae	186	142 (76.3)	13 (6)	14.3
15. Asphodelaceae	162	85 (52.5)	8 (0)	20.3
16. Geraniaceae	155	91 (58.7)	3 (0)	51.7
17. Polygalaceae	142	123 (86.6)	3 (0)	47.3
18. Rhamnaceae	137	126 (91.9)	5 (1)	27.4
19. Crassulaceae	129	40 (31.0)	5 (0)	25.8
20. Thymelaeaceae	127	91 (71.6)	4 (1)	31.8
Total	7 022	5 248 (74.6)	515 (112)	13.6

*Genera.* A total of 942 genera of seed plants (or 988 genera of vascular plants) were included in the Cape flora by Goldblatt & Manning (2000), comprising about half of all those occurring in southern Africa. Of those, some 160 genera (all of them seed plants), were endemic, constituting 16.2% of the total vascular plant flora. The inclusion of Tamaricaceae in the flora adds one more genus, *Tamarix*, and the recent discovery of a species of *Clivia* Lindl. (Amaryllidaceae) in the Cape flora (Rourke 2002) is a second generic addition. The genus *Piulularia* L. (Marsileaceae) has also recently been recorded for the first time in the flora (Roux 2002). *Carpolyza* Salisb. (Amaryllidaceae) has been found by molecular analysis to be nested in *Strumaria* Jacq. ex Willd., in which it is now included (Meerow & Snijman 2001). Also in Amaryllidaceae, the monotypic *Cybisetes* Milne-Redh. & Schweick. is now included in *Ammocharis* Herb. (Snijman & Archer 2003). In Aizoaceae, some species previously assigned to *Lampranthus* N.E.Br. and *Ruschia* Schwantes are now referred to the new endemic genera

*Brianhuntleya* Chesselet, S.A.Hammer & I.Oliver (monotypic) (Chesselet *et al.* 2003), and *Phiambolia* Klak (7 species) (Klak 2003).

Old herbarium records, until now overlooked, show that *Calystegia* R.Br. (Convolvulaceae) and *Chaetaceae* Planch. (Celtidaceae) occur naturally in the Cape flora, adding another two genera to the total. Another generic omission is *Gomphostigma* Turcz., now added to Scrophulariaceae. In Asteraceae, a new monospecific genus *Roodebergia* B.Nord. has been described (Nordenstam 2002b) and two species of *Dicoma* Cass. have been transferred to *Macedium* Cass., thus adding two more genera to the flora. The endemic genus *Alciope* DC. (Asteraceae), has been found to be nomenclaturally illegitimate, and is now called *Capelio* B.Nord. (Nordenstam 2002a, 2003a). Lastly, in Hyacinthaceae the endemic species *Scilla plumbea* has been shown by molecular data to be misplaced generically and has been assigned to the new and endemic genus *Spetaea* Wetschnig & Pfosser, as *S. lachenaliiflora* Wetschnig & Pfosser (2003). Also in Hyacinthaceae, *Albuca* L., *Dipcadi* Medik. and *Neopatersonia* Schönland have been sunk in *Ornithogalum* L., *Whiteheadia* Harv. in *Massonia* Thunb. ex Houtt., and *Polyxena* Kunth is included in *Lachenalia* J.Jacq. ex Murray (Manning *et al.* 2004). This reduces the number of genera but significantly enlarges *Ornithogalum*, which now has 72 species (previously 40 species) in the Cape flora, while *Lachenalia* now has 69 species in the flora.

Recent molecular studies on Zygophylloideae (Beier *et al.* 2003) have resulted in substantial restructuring of the genera in the subfamily. *Zygophyllum* L. is now understood to be restricted to Asia and the majority of the southern African species of *Zygophyllum* have been referred to the genus *Roepera* A.Juss. The species of *Zygophyllum* subg. *Agrophyllum* Endl. are placed in the genus *Tetraena*.

With these changes there are currently 948 genera of seed plants, or 992 genera of vascular plants recognized in the CFR. This is an increase of four genera to the previous total for the flora (Goldblatt & Manning 2000). Of these, 162 genera (16.3%) are endemic, representing an insignificant increase in generic endemism over that recorded in *Cape plants*. Thirteen genera have more than 100 species and the 20 largest genera contribute some 2 858 species, or 31.5% of the total in the flora (Table 2).

TABLE 2.—Ranking by numerical size of the twenty largest genera in the CFR (endemic species number) from Goldblatt & Manning (2000, 2002a) with changes following this paper

<i>Erica</i>	667 (644)	<i>Muraltia</i>	107 (101)
<i>Aspalathus</i>	272 (256)	<i>Gladiolus</i>	106 (86)
<i>Pelargonium</i>	148 (88)	<i>Selago</i>	100 (76)
<i>Agathosma</i>	143 (138)	<i>Crassula</i>	97 (28)
<i>Phyllica</i>	133 (126)	<i>Disa</i>	92 (78)
<i>Lampranthus</i>	119 (113)	<i>Ruschia</i>	83 (66)
<i>Oxalis</i>	119 (94)	<i>Restio</i>	85 (82)
<i>Moraea</i>	116 (80)	<i>Leucadendron</i>	82 (79)
<i>Cliffortia</i>	114 (103)	<i>Helichrysom</i>	81 (34)
<i>Senecio</i>	113 (56)	<i>Thesium</i>	81 (35)
Total in largest		Total in largest	
10 genera: 1 944 spp.		20 genera: 2 858 spp.	
(21.4% of the flora)		(31.5% of the flora)	

*Species.* The number of species added to the flora is considerable and we list changes below by family alphabetically. New inclusions are provided with treatments comparable to those in *Cape plants*, including brief descriptions, and notes on flowering time, distribution, habitat, and phytogeographic centre(s) within the Cape Region. Corrections to species names, descriptions, or ranges are included in the list that follows. The sign \* indicates endemic to the CFR and the sign ! indicates introduced species. With the additions and corrections, the Cape flora now includes 9 086 species of vascular plants, 6 226 endemic (8 971 species of seed plants, 6 217 endemic) with a percentage endemism of 68.5 %. This represents an increase of 80 species since the publication of *Cape plants* and a reduction in endemism from 68.8%. In Table 1 we list the ten largest families in the flora with their number of species and degree of endemism.

Six phytogeographical subcentres are recognized in the Cape Region and their abbreviations used here are: NW (Northwest Centre); SW (Southwest Centre); AP (Agulhas Plain); KM (Karoo Mountain Centre); LB (Langeberg Centre); and SE (Southeast Centre) (see front endpaper of *Cape plants*).

AIZOACEAE

- Acrodon deminutus** Klak Spreading, tufted succulent shrublet to 10 cm. Leaves trigonous, free almost to base, margins toothed. Flowers with petals magenta at base and tips, white between, stamens white with magenta tips, 15–20 mm diam. Capsule 5-locular, 7–8 mm diam. Sept. Stony quartz outcrops on clay, SW (Swellendam to Bredasdorp)\* (Klak 2003).
- Amphibolia hutchinsonii* (L.Bolus) H.E.K.Hartmann is a synonym of *A. laevis* (Aiton) H.E.K.Hartmann (Hartmann 2001).
- Antimima aristulata** (Sond.) Chesselet & Gideon F.Sm. is a new combination for *Ruschia aristulata* (Sond.) Schwantes (Chesselet & Smith 2001).
- Antimima insidens** (L.Bolus) Chesselet is a new combination for *Ruschia insidens* L.Bolus (Chesselet 2001).
- Antimima viatorum** (L.Bolus) Klak is a new combination for *A. bina* (L.Bolus) H.E.K.Hartmann. NW, SW (Namaqualand to Malmesbury). Revised distribution, not endemic (Klak 2003).
- Brianhuntleya** Chesselet, S.A.Hammer & I.Oliver is a new genus for the flora (Chesselet *et al.* 2003).
- Brianhuntleya intrusa** (Kensit) Chesselet, S.A.Hammer & I.Oliver [= *Ruschia intrusa* (Kensit) L.Bolus] Tufted succulent, 7–10 cm, with spreading branches, bearing persistent dry leaves. Leaves swollen-trigonous, obtuse, entire, ± 55 × 8 mm, grey-green. Flowers solitary, to 35 mm diam., with an intrusive calyx tube, pale rose-purple. Fruits 5-locular. June–July. Shale slopes, NW (Worcester Karoo)\*. Revised description.
- Drosanthemum asperulum** (Salm-Dyck) Schwantes is a new combination for *Delosperma asperulum* (Salm-Dyck) L.Bolus (Klak 2003).
- Drosanthemum quadratum** Klak Like *D. asperulum* but plants smaller, to 15 cm high, with thicker leaves 2–4 mm wide, and wider capsules 5–10 mm diam. Sept.–Oct. Stony quartz outcrops on clay slopes, SW (Swellendam to Bredasdorp)\* (Klak 2003).
- Erepsia simulans** (L.Bolus) Klak Laxly branched succulent shrublet to 16 cm. Leaves shortly fused toward base, narrowed near tips, acute to obtuse. Flowers silvery white, tipped with pink. Capsules 7-locular. Oct. Limestone flats, AP (Agulhas Peninsula: Brandfontein)\* (Klak 2003).
- Esterhuysenia mucronata** (L.Bolus) Klak is the correct name for *Lampranthus mucronatus* L.Bolus (Klak 2003).
- Lampranthus gydouwensis* (L.Bolus) H.E.K.Hartmann is a synonym of **Phiambolia incumbens** (L.Bolus) Klak (Klak 2003).
- Machairophyllum acuminatum* L.Bolus is a synonym of **M. bijliae** (N.E.Br.) L.Bolus (Kurzweil & Chesselet 2003).
- Machairophyllum baxteri* L.Bolus is a synonym of **M. bijliae** (N.E.Br.) L.Bolus (Kurzweil & Chesselet 2003).
- Machairophyllum bijliae** (N.E.Br.) L.Bolus Tufted perennial to 20 cm. Leaves pale green, trigonous, angles acute. Flowers solitary on



pedicels to 75 mm long, golden yellow with red reverse or red, 50–60 mm diam. Mostly Oct.–Nov. Rocky slopes and rock crevices, KM, SE (Swartberg Pass to Uniondale and George to Humansdorp and E Cape). Revised description and range, no longer endemic (Kurzweil & Chesselet 2003) (not *M. bijlii*).

*Machairophyllum cookii* (L.Bolus) Schwantes is a synonym of *M. albidum* (L.) Schwantes (Kurzweil & Chesselet 2003).

*Machairophyllum latifolium* L.Bolus is a synonym of *M. brevifolium* L.Bolus (Kurzweil & Chesselet 2003).

*Machairophyllum stayneri* L.Bolus does not occur in the CFR.

*Oscularia comptonii* (L.Bolus) H.E.K.Hartmann is a new name for *O. ebracteata* (L.Bolus) H.E.K.Hartmann. Stony slopes, NW (Namaqualand to Olifants River Valley). Corrected distribution, not endemic (Klak 2003).

*Phiambolia* Klak is a new genus for some species previously of *Lampranthus* and *Ruschia* (Klak 2003).

*Phiambolia franciscii* (L.Bolus) Klak Succulent shrub to 60 cm. Leaves 25–40 × 3–6 mm, fused at base into a sheath, 4–5 mm long, papillate-velvety. Flowers in cymes, pink, 30–45 mm diam. Fruits funnel-shaped. Oct.–Nov. Mainly stony sandstone slopes, NW (Cold Bokkeveld to Karooport).\*

*Phiambolia hallii* (L.Bolus) Klak Prostrate succulent rooting at nodes, branches to 30 cm. Leaves joined for 3–4 mm, free parts 20–35 mm, 4–6 mm diam. Flowers to 35 mm diam., solitary on pedicels, 15–25 mm long, pink. Fruits funnel-shaped. July. Sandstone and shale outcrops, NW (Swartuggens: Katbakkies to Karooport).\*

*Phiambolia incumbens* (L.Bolus) Klak is a new combination for *Ruschia incumbens* L.Bolus.

*Phiambolia mentiensi* Klak Shrublet to 35 cm, with smooth internodes, 25–40 mm long. Leaves basally fused, subterete, 13–25 × 4–6 mm, with recurved mucronate tips. Flowers in few-flowered cymes, petals magenta, filamentous staminodes in a cone, white with magenta tips. Fruits funnel-shaped. Sept. Sandstone rocks, NW (Cederberg Mtns to Karooport).\*

*Phiambolia persistens* (L.Bolus) Klak is a new combination for *Lampranthus persistens* (L.Bolus) Klak Sandy and stony slopes, NW, KM (Bokkeveld Mtns and Witteberg).\* Revised range.

*Phiambolia stayneri* (L.Bolus ex Toelken & Jessop) Klak is a new name for *Lampranthus dissimilis* (G.D.Rowley) H.E.K.Hartmann) Stony slopes, NW (Ceres: Warm Bokkeveld).\* Corrected range.

*Phiambolia unca* (L.Bolus) Klak is a new combination for *Lampranthus unca* (L.Bolus) H.E.K.Hartmann Stony slopes and flats, NW (Bokkeveld Mtns to Ceres).\* Revised range.

*Ruschia knysnana* (L.Bolus) L.Bolus Sandstone slopes, SE (Knysna to Grahamstown). Revised distribution, not endemic.

*Ruschia pulchella* (Haw.) Schwantes is now regarded as an insufficiently known species and must be removed from the account of *Ruschia* (Chesselet & Smith 2001).

Current total: genera 77; species 658 (previously 76 genera and 661 species).

## ALLIACEAE

*Tulbaghia capensis* L. SW, AP, LB, SE (Namaqualand, Cape Peninsula to Long Kloof). Revised range, not endemic.

## AMARANTHACEAE

*Sarcocornia* sp. 1. Woody jointed shrublet to 60 cm, branches 2 mm diam. Leaves fleshy. Flowering time? Saline washes in renoster-veld, NW (Endekuil Flats).\*

Current total: genera 12; species 23 (previously 12 genera and 22 species).

## AMARYLLIDACEAE

*Ammocharis longifolia* (L.) M.Roem. is the correct name for *Cydistetes longifolia* (L.) Milne-Redh. & Schweick. (Snijman & Archer 2003).

*Brunsvigia elandsmontana* Snijman Bulbous geophyte to 20 cm. Leaves dry at flowering, 4–6, prostrate. Flowers 6–18 in a compact, hemispherical head, actinomorphic, deep pink, tepals widely flared, stamens about as long as tepals, central. Capsules 3-angled. Mar.–May. Stony flats, SW (Hermont)\* (Snijman 2001a).

*Carpolyza* Salisb. is now included in *Strumaria* (Meerow & Snijman 2001).

*Clivia Lindl.* is added to the flora (Rourke 2002).

*Clivia mirabilis* Rourke Rhizomatous perennial to 80 cm. Leaves several, linear, often with a whitish midline, 30–40 mm wide. Flowers tubular, nodding, reddish with green to yellow tips, pedicels red-

dish, ± 25 mm long. Oct.–Nov. Wooded scree, NW (Bokkeveld Mountains)\*.

*Cydistetes* Milne-Redh. & Schweick. is now included in *Ammocharis* (Snijman & Archer 2003).

*Cyrtanthus debilis* Snijman is a new species for *Cyrtanthus* sp. 2 (Snijman 2001b).

*Gethyllis linearis* L.Bolus Bulbous geophyte to 6 cm, forming compact clumps. Leaves dry at flowering, spreading, tightly coiled, glabrous and subsucculent. Flowers white tinged pink, anthers 6. Oct.–Nov. Gravelly flats, NW (S Namaqualand to Bokkeveld Mtns) (Manning *et al.* 2002).

*Gethyllis oliverorum* D.Müll.-Doblies Bulbous geophyte up to 40 mm. Leaves dry at flowering, linear, glabrous or subglabrous, curved and spreading on ground or slightly ascending. Flowers white to pale pink, anthers 6. Fruit almost dry. Nov.–Dec. Shallow soil on rocks, NW (Heerenlogement, near Vanrhynsdorp, N Cederberg).\*

*Strumaria spiralis* (L'Hér.) Snijman is the correct name for *Carpolyza spiralis* (L'Hér.) Salisb.

Current total: genera 15; species 97 (previously 16 genera and 93 species).

## ANTHERICACEAE

*Chlorophytum comosum* (Thunb.) Jacques (not Jacq.).

## APIACEAE

*Centella* with 49 species is transferred here from Araliaceae.

Current total: genera 24; species 121 (previously 23 genera and 72 species).

## APOCYNACEAE (P. Bruyns pers. comm.)

*Pachypodium succulentum* (Jacq.) Sweet (not (L.f.) A.D.C.).

*Stapelia obducta* L.C.Leach Leafless succulent with erect, 4-angled stems, 10–20 mm diam., forming dense clumps, 10–25 cm; sap clear. Flowers 50 mm diam., button-like with strongly recurved lobes, purple-brown, softly hairy on inner surface throughout. Mar.–Oct. stony sandstone slopes, SE (Great Winterhoek Mtns).\* Not conspecific with *S. hirsuta*.

*Tromotriche choanantha* (Lavranos & H.Hall) Bruyns (not (Lavranos & A.V.Hall) Bruyns).

Current total: genera 36; species 113 (previously 36 genera and 112 species).

## ARALIACEAE

*Centella* with 49 species is transferred to Apiaceae.

Current total: genera 3; species 6 (previously 4 genera and 55 species).

## ASPHODELACEAE

*Bulbine cremnophila* Van Jaarsv. Dwarf perennial to 30 cm, roots fleshy, grey. Leaves rosulate, fleshy, narrowly lanceolate, glaucous. Flowers in a lax raceme, yellow. Capsules ovoid, erect. Aug.–Feb. Sandstone cliff faces, SE (Humansdorp)\* (Van Jaarsveld & Van Wyk 1999).

*Bulbine melanovaginata* G.Will. (Williamson 2003) is included in *Bulbine foleyii* E.Phillips.

*Bulbine meiringii* Van Jaarsv. Dwarf geophyte to 30 cm, clustered, rootstock a small tuber with fleshy roots. Leaves slender and fleshy, semi-terete, surrounded at base by a short fibrous neck. Flowers in a lax raceme, yellow. Capsules ovoid, erect. June–Sept. Rocky sandstone ledges, KM (Swartberg Mtns)\* (Van Jaarsveld 2003).

*Bulbine navicularifolia* G.Will. (Williamson 2003) is included in *Bulbine succulenta* Compton.

*Bulbine ramosa* Van Jaarsv. Branching geophyte to 50 cm, forming clusters, stems globose below with fleshy roots. Leaves linear-lanceolate, bright green. Flowers in a lax raceme, yellow. Capsules ovoid, erect. Nov. Sandstone cliff faces, KM (Calitzdorp: Bads-poor)\* (Van Jaarsveld 2003).

*Gasteria polita* Van Jaarsv. Like *G. acinacifolia* but smaller, up to 60 cm in flower, and usually solitary; raceme usually unbranched and flowers smaller, 35 mm long. Oct.–Nov. Slopes and embankments in forest, SE (Plettenberg Bay)\* (Van Jaarsveld 2001).

*Gasteria vlokii* Van Jaarsv. KM (Swartberg Mtns to Willowmore). Range correction.

*Haworthia bruynsii* M.B.Bayer does not occur in the CFR.

*Haworthia pubescens* M.B.Bayer NW (Worcester-Robertson Karoo)\*. Range correction.



Current total: genera 8; species 161 (previously 8 genera and 157 species).

ASTERACEAE (*Othonna* and *Senecio* corrections, P.V.Bruyns pers. comm.)

**Arctotheca marginata** Beyers Prostrate perennial rooting at nodes, softly hairy. Leaves linear-elliptic, margins crisped and rolled under, softly hairy above and felted beneath. Flower heads radiate, solitary on felted scapes, yellow with rays reddish outside, involucre bracts felted. Achenes woolly, pappus wanting. Oct.–Nov. Sandy edges of pans, NW (Bokkeveld Mtns)\* (Beyers 2002).

**Athanasia trifurcata** (L.) L. NW, SW, AP, KM, LB, SE (Springbok to Port Elizabeth). Revised range, not endemic.

**Capelio** B.Nord. is a new name for *Alciopie* DC. (Nordenstam 2002a, 2003a).

**Capelio caledonica** B.Nord. is a new species for *Alciopie* sp. 1. (Nordenstam 2002a, 2003a).

**Capelio tabularis** (Thunb.) B.Nord. is a new combination for *Alciopie tabularis* Thunb. (Nordenstam 2002a, 2003a).

**Capelio tomentosa** (Burm.f.) B.Nord. is a new name for *Alciopie lanata* (Thunb.) DC. (Nordenstam 2002a, 2003a).

**Dimorphotheca nudicaulis** (L.) DC. (not (L.) B.Nord.).

**Felicia josephinae** J.C.Manning & Goldblatt is a new species for *Felicia* sp. 1. (Manning & Goldblatt 2002).

**Gazania pectinata** (Thunb.) Hartweg (not (Thunb.) Spreng.) (Mabberley 1980).

**Macleodium** Cass. is now recognized in the Cape flora for two of the four species of *Dicola* in the flora (Ortiz 2001).

**Macleodium rehanioides** (Less.) S.Ortiz is a new combination for *Dicola rehanioides* Less. (Ortiz 2001).

**Macleodium spinosum** (L.) S.Ortiz is a new combination for *Dicola spinosum* L. (Ortiz 2001).

**Marasmodes oligocephala** DC. (not *M. oligocephalus* DC.).

**Masarmodes polycephala** DC. (not *M. polycephalus* DC.).

**Oedera epaleacea** Beyers Twiggy shrublet to 60 cm. Leaves oblanceolate, spreading, gland-dotted. Flower heads radiate, few in slender peduncles in lax umbels, yellow, disc florets female-sterile. Achenes hairy. June–Sept. Sandstone outcrops in cracks, NW (Swartuggens)\* (Beyers 2001).

**Osteospermum australe** B.Nord. is a new species for *Osteospermum* sp. 2 (Nordenstam 2004).

**Osteospermum burttianum** B.Nord. Densely leafy, glabrescent rounded or spreading shrublet to 1 m. Leaves oblong-lanceolate, leathery, ascending, margins minutely scabrid. Flower heads radiate, solitary on short, roughly hairy peduncles, yellow. Achenes obscurely ribbed, 5–7 mm long. Mainly Dec.–May. Rocky sandstone slopes, LB (Langeberg near Heidelberg)\* (Nordenstam 2004).

**Osteospermum potbergensis** A.R.Wood & B.Nord. Decumbent to prostrate shrublet to 20 cm. Leaves leathery, petiolate, often sparsely dentate, margins curved under. Flower heads radiate, single on white-woolly peduncles, yellow. July–Dec. Stony lower slopes, SW (Potberg)\* (Wood & Nordenstam 2003).

**Othonna alba** Compton Like *O. cylindrica* but leaves long and slender, almost filiform and rays usually white. Aug.–Oct. Sandy plateaus, NW (Botterkloof, Cederberg, Anysberg).\* Previously included in *O. cylindrica*.

**Othonna carnosa** Less. Succulent shrublet with short, erect or sprawling branches, 10–30 cm. Leaves fleshy, ovoid to fusiform. Flower heads radiate, few in lax, terminal cymes on slender peduncles, yellow. Mainly Apr.–Oct. Stony flats and slopes, NW, SW, AP, KM, LB, SE (Namaqualand to Worcester to E Cape).

**Othonna cylindrica** (Lam.) DC. NW, SW (S Namibia to Langebaan). Corrected range and taxonomy.

**Othonna floribunda** Schltr. does not occur in the flora, and is restricted to Namaqualand.

**Othonna spinescens** DC. Spiny shrub, older branches slender and stiff. Leaves tufted on short shoots, narrowly oblanceolate, coriaceous, felted in axils. Flower heads radiate, solitary on short terminal peduncles, yellow; pappus of marginal florets elongating in fruit. Sept. Rocky sandstone slopes, NW, KM (Cederberg and Swartuggens to Witteberg).\*

**Pteronia undulata** DC. Like *P. divaricata* but leaves strongly undulate or crisped, glandular-papillate. Sept.–Oct. Rocky slopes, NW (Namaqualand, Swartuggens).

**Pteronia viscosa** Thunb. Twiggy shrublet, 30–100 cm. Branchlets whitish, glabrous. Leaves oblong-lanceolate, keeled, leathery, setulose-ciliate. Flower heads discoid, solitary at branch tips, yellow, 20–25 × ± 15 mm; bracts rough, margins obscurely fringed. Oct.–Dec. Rocky slopes, NW, KM (Namaqualand, W Karoo to E Cape, Swartuggens, Little Karoo: Ladismith).

**Roodebergia** B.Nord. is a new monotypic genus and species for the flora. It is probably close to *Felicia* (Nordenstam 2002b).

**Roodebergia kitamuraana** B.Nord. Diffuse perennial rooting at nodes to 20 cm. Leaves opposite, elliptic, roughly hairy. Flower heads discoid, solitary, reddish purple. Jan. Rocky sandstone slopes, 1 850 m, NW (Hex River Mtns)\* (Nordenstam 2002b).

**Schistostephium umbellatum** (L.f.) K.Bremer & Humphries (not *S. umbellata* (L.f.) K.Bremer & Humphries).

**Senecio addoensis** Compton Like *S. scaposus* but leaves apically toothed or lobed. Mar. Stony sandstone slopes, SE (Great Winterhoek Mtns and E Cape).

**Senecio articulatus** (L.) Sch.Bip. KM, SE (Montagu to Uitenhage and Great Karoo). Revised range, not endemic.

**Senecio corymbiferus** DC. Gnarled or erect succulent shrub with cane-like stems, 30–200 cm. Leaves fusiform, glaucous, striate. Flower heads discoid, in sparse corymbs clustered apically, yellow. Mar.–July. Rocky hills, often granite, NW (S Namibia to Cederberg and Swartuggens).

**Senecio ficoides** (L.) Sch.Bip. KM (Swartberg Mtns to Suurburg). Revised range, not endemic.

**Senecio haworthii** (Sweet) Sch.Bip. Thick-stemmed, white-felted shrub to 70 cm. Leaves in terminal clusters, cylindric or fusiform, succulent, white-felted. Flower heads discoid, yellow, large, mostly solitary on thickly felted peduncles, involucre sandcycled. Nov.–Mar. Rocky slopes, KM (Richtersveld and W Karoo to Witteberg Mtns).

**Senecio littoreus** Thunb. NW, SW (Namaqualand: Koekenaap to Cape Peninsula and Napier). Revised range, not endemic.

**Senecio ovoideus** (Compton) H.Jacobsen (= *Kleinia ovoidea* Compton, *Senecio* sp. 5) Like *S. crassulaefolius* but leaves thicker, ovoid and obtuse, Dec.–June. Dry stony slopes, KM (western Little Karoo).\* Previously included in *S. crassulaefolius* (DC.) Sch.Bip.

**Stoebe nervigera** (DC.) Sch.Bip. NW, SW, LB (Namaqualand to Albertinia). Revised range, not endemic.

**Syncarpha aurea** B.Nord. is a new species for *Syncarpha* sp. 4 (Nordenstam 2003b).

**Syncarpha chlorochrysum** (DC.) B.Nord. is a new combination for *Syncarpha* sp. 1 (Nordenstam 2003b).

**Syncarpha mucronata** (P.J.Bergius) B.Nord. is a new combination for *Syncarpha* sp. 2 (Nordenstam 2003b).

**Syncarpha staehelina** (L.) B.Nord. is a new combination for the species to which the name *Syncarpha virgata* (P.J.Berg.) B.Nord. was misapplied (Nordenstam 2003b).

**Syncarpha virgata** (P.J.Bergius) B.Nord. is to be applied to *Syncarpha* sp. 3 in *Cape plants* (Nordenstam 2003b).

**Tarchonanthus littoralis** P.P.J.Herman is a new species segregated from *T. camphoratus* L. for the genus in the CFR. The revised range is SW, AP, ?KM, LB, SE (Cape Peninsula to S KwaZulu-Natal) (Herman 2002).

Current total: genera 123; species 1 047 (previously 121 genera and 1 035 species).

## BORAGINACEAE

**Trichodesma africanum** (L.) Sm. (not (L.) Lehm.) (Mabberley 1980: 605).

## BUDDLEJACEAE

*Buddleja* L. with three species has been removed to Scrophulariaceae.

Current total: genera 0; species 0 (previously 1 genus; 3 species).

CAMPANULACEAE (*Merciera* corrections, C.N. Cupido pers. comm.; *Grammatotheca* correction, E. Knox pers. comm.).

*Grammatotheca* sp. 1 of *Cape plants* is *Lobelia thermalis* Thunb. (a species included in *Cape plants*).

**Merciera azurea** Schltr. Rigid, closely leafy shrublet to 30 cm. Leaves imbricate, stiffly linear, pungent, shortly hairy, margins slightly revolute and roughly ciliate. Flowers subsessile in upper axils, blue to purple, tube narrowly funnel-shaped, 10–25 mm long, petals elliptic-lanceolate. Nov.–Feb. Sandstone slopes, SW (Sir Lowry's Pass to Bredasdorp).\*

**Merciera brevifolia** A.DC. Like *M. leptoloba* but leaves shorter, less than 8 mm long and petals ovate. Nov.–Feb. Shale or granite slopes, SW (Houwhoek to Caledon Swartberg).\* Revised description and range.

**Merciera eckloniana** H.Buek. ex Eckl. & Zeyh. Like *M. azurea* but plants slender and leaves scattered. Oct.–Feb. Rocky slopes, NW, SW (Tulbagh to Groenland Mtns).\* Previously a synonym of *M. brevifolia* A.DC.

*Merciera leptoloba* A.DC. Rigid, closely leafy shrublet to 30 cm. Leaves imbricate, stiffly linear, pungent, shortly hairy, margins lightly revolute and harshly ciliate, axillary leaves glabrous. Flowers subsessile in upper axils, white, tube slender, 3–6 mm long, petals linear-lanceolate. Nov.–Mar. Sandy flats and lower slopes, SW, AP (Kogelberg to Bredasdorp). \* Revised description and range.

*Merciera tenuifolia* (L.f.) A.DC. Like *M. azurea* but axillary leaf tufts present and corolla tube cylindrical. Dec.–Jan. Rocky slopes, SW (Houhoek to Kogelberg). \* Revised description and range.

*Merciera tetraloba* C.N.Cupido Like *M. leptoloba* but floral parts in fours, petals tipped mauve. Nov.–Feb. Clay and granite flats, SW (Du Toitskloof to Gordon's Bay). \* (Cupido 2002).

*Wahlenbergia debilis* H.Buck is the correct name for *W. ramulosa* E.Mey. ex DC. (T. Lammers pers. comm.).

Current total: genera 13; species 186 (previously 13 genera and 184 species).

## CELTIDACEAE

*Chaetacme* Planch. is added to the flora (Wilmot-Dear 1999).

*Chaetacme aristata* Planch. Monoecious scrambling shrub or small tree with zig-zag branches and paired axillary spines. Leaves elliptic, aristate, glossy. Flowers unisexual, in axillary cymes, greenish or cream. Flowering time? Coastal and riverine forest, SW, SE (Knysna to tropical Africa and Madagascar).

Current total: genera 2; species 2 (previously 1 genus and 1 species).

## CERATOPHYLLACEAE

*Ceratophyllum muricatum* Cham. Monoecious, free-floating aquatic herb to 3 m. Leaves whorled, aristate and mostly 3- or 4-branched, margins sparsely cuspidate. Flowers unisexual, usually solitary at nodes. Fruit warty with three slender spines. Flowering time? Sluggish and stagnant fresh water, LB, SE (George to Old World Tropics) (Wilmot-Dear 1997).

Current total: genera 1; species 2 (previously 1 genus and 1 species).

## CONVOLVULACEAE

*Calystegia sepium* (L.) R.Br. Glabrous climber to 3 m. Leaves hastate-sagittate. Flowers white or pink, 50–55 mm long, sepals broadly lanceolate; bracts ovate-cordate, longer than calyx. Dec.–Jan. Bush, SW (Cape Peninsula, northern hemisphere native now naturalized along the Atlantic coasts of both hemispheres)! (Meeuse & Welman 2000).

*Calystegia soldanella* (L.) R.Br. Glabrous creeping perennial to 50 cm, forming large mats. Leaves reniform and emarginate, subsucculent. Flowers pink to pale purple, 25–40 mm long, sepals ovate; bracts ovate-suborbicular, shorter than calyx. Nov.–Dec. Coastal sands, AP (Stilbaai, nearly pantemperate).

Current total: genera 6; species 18 (previously 5 genera and 17 species).

## CORNACEAE

*Curtisia dentata* (Burm.f.) C.A.Sm. has been removed to Curtisiaceae.

Current total: family no longer represented in the flora (previously 1 genus; 1 species).

## CRASSULACEAE (P. Bruyns pers. comm.)

*Adromischus bicolor* Hutchison does not occur in the CFR.

*Adromischus maculatus* (Salm-Dyck) Lem. KM (Willowmore District, Georgidia, and E Cape). Corrected distribution.

*Adromischus subdistichus* Makin ex Bruyns Succulent perennial to 30 cm. Leaves suborbicular, brownish green without waxy bloom. Flowers in a spicate cyme, greenish with purple stripes, petals grooved, ovate, fused basally, anthers just exerted. Jan.–Feb. N-facing sandstone and quartzite ridges, KM (Swartberg Mtns). \*

*Adromischus triflorus* (L.f.) Berger KM, SE (Touws River to Great Karoo and E Cape). Corrected distribution.

*Cotyledon muirii* Schonl. (incl. *C. eliseae* Van Jaarsv.) Small shrublet to 60 cm. Leaves obovate, green. Flowers several in a pedunculate cyme, nodding, reddish, usually glandular, lobes twice as long as tube. Mainly Oct.–Dec. Stony slopes, LB (Gouritz River Valley). \*

*Cotyledon papillaris* L.f. Delicate sprawling shrublet with decumbent branches to 25 cm long, rooting at nodes. Leaves linear-oblanco- late to fusiform, green. Flowers several in a pedunculate cyme, nodding, reddish, usually glandular, lobes twice as long as tube. Mainly Oct.–Dec. Gravelly slopes, KM (Little and Great Karoo).

*Crassula badspoortense* Van Jaarsv. Like *C. perfoliata* but leaves broadly ovate and rounded inflorescence. Nov.–Feb. Sandstone cliffs, KM (Calitzdorp: Badspoort). \*

*Crassula cremnophila* Van Jaarsv. & A.E.van Wyk Like *C. hemisphaerica* but leaves broadly obovate, flowers in a rounded thyrse, petals 7 mm long and anthers black. Aug.–Feb. Sandstone cliff faces, SE (Baviaanskloof and Kouga). \*

*Crassula deceptor* Schonl. & Baker. Listed twice in *Cape plants*.

*Crassula perfoliata* L. Densely papillate, few-branched perennial to 1.5 m. Leaves opposite, lanceolate to triangular, green to grey sometimes with purple blotches. Flowers in flat-topped, pedunculate clusters, tubular, white, pink or red, petals 3–6 mm long. Oct.–Jan. Dry lower slopes, SE (Karoo and Uitenhage to Limpopo).

*Tylecodon albidiflorus* Bruyns Succulent shrublet to 20 cm. Leaves dry at flowering but not abscising, oblanceolate. Flowers in a narrow cyme, funnel-shaped with spreading lobes, green but white with reddish stripes in throat, tube 12–15 mm. Nov.–Feb. Renosterveld, KM (Montagu to Barrydale). \*

*Tylecodon stenocaulis* Bruyns Succulent shrublet to 30 cm. Leaves dry at flowering but not abscising, oblanceolate. Flowers in a delicate cyme, urn-shaped, yellowish green but purple in throat, tube 11–13 mm. Sept.–Mar. Dry slopes, NW (Swartuggens and Tanqua Karoo).

Current total: genera 5; species 129 (previously 5 genera and 123 species).

## CUCURBITACEAE

*Kedrostis psammophila* Bruyns Monoecious tuberous perennial, prostrate with stems to 1 m long, without tendrils. Leaves palmate. Flowers borne at ground level on subterranean peduncles, male fascicled, female solitary, greenish. Fruits berry-like, subterranean. Apr.–June. Reddish sands, NW (Namaqualand to Redelinghuys) (Bruyns 1993).

Current total: genera 5; species 8 (previously 5 genera; 7 species).

## CURTISIACEAE

*Curtisia dentata* (Burm.f.) C.A.Sm. is transferred here from Cornaceae.

Current total: genera 1; species 1 (family not previously included in the flora).

## CYPERACEAE

*Isolepis incomtula* Nees (not *I. incomptula* Nees).

## DENNSTAEDTIACEAE

*Hypolepis villosa-viscida* (Thouars) Tardieu Rhizomatous perennial. Fronds suberect to arching, to 1 m long, stipe hairy, lamina 3-pinnate-pinnatifid. Sori in 1 to 3 pairs on ultimate segments, pseudostrobilus often strongly modified, receptacle haired. Perennial streambanks and seeps, ± 50–760 m, SW (Peninsula to Genadendal and E Cape, also S Atlantic Islands) (Roux 2001).

Current total: genera 4; species 6 (previously 4 genera; 5 species).

## ERICACEAE

*Erica amalophylla* E.G.H.Oliv. & I.M.Oliv. Sprawling diffuse shrublet. Flowers small, cup-shaped, white, thinly hairy. Dec. Sandstone shelters, NW (Twenty Four Rivers Mtns)\* (Oliver & Oliver 2002b).

*Erica anenodes* E.G.H.Oliv. Compact shrublet to 50 cm. Flowers small, campanulate, white. Nov. Sandstone slopes, NW (Hex River Mtns and Keeromsberg)\* (Oliver & Oliver 2001a).

*Erica annalis* E.G.H.Oliv. & I.M.Oliv. Erect shrublet to 1 m. Flowers large, tubular, orange-red, shortly hairy. July–Oct. Quartzite rock faces, KM (Kammanassie Mtns)\* (Oliver & Oliver 2002b).

*Erica blaerioides* E.G.H.Oliv. Compact shrublet to 30 cm. Flowers small, urceolate, white, shortly hairy. Dec.–Jan. Sandstone slopes at high alt., KM (Swartberg Mtns)\* (Oliver & Oliver 2001b).

*Erica breviflora* Dulfer is a synonym of *Erica plukenetii* L. (Oliver & Oliver 2002a).

*Erica casta* Guthrie & Bolus is a synonym of *Erica regia* Bartl. (Oliver & Oliver 2002a).

*Erica cavartica* E.G.H.Oliv. & I.M.Oliv. Diffuse procumbent shrublet. Flowers small, shortly tubular, hairy. Mar. Sandstone shelters, NW (Cederberg Mtns)\* (Oliver & Oliver 2002b).

*Erica chionodes* E.G.H.Oliv. Compact shrublet to 60 cm. Flowers small, urceolate, white, finely hairy. Sept.–Nov. Sandstone seeps, KM (Grootswartberg Mtns)\* (Oliver & Oliver 2001b).

*Erica cymosa* E.Mey. ex Benth. Sprawling diffuse shrublet. Flowers small, campanulate, white to pale pink, sparsely hairy. Oct.–Mar. Sandstone shelters, NW, SW (Hex River and Du Toitskloof Mtns to Keeromsberg)\* Revised description and range.

*Erica comptonii* T.M.Salter is a synonym of *Erica banksii* Andrews (Oliver & Oliver 2002a).

*Erica decora* Andrews is a synonym of *Erica viscaria* L. (Oliver & Oliver 2002a).

*Erica dolifiana* E.G.H.Oliv. Compact shrublet to 50 cm. Flowers small, campanulate-urceolate, white or tinged pink. Oct.–Dec. Sandstone slopes at high alt., KM (Grootswartberg Mtns)\* (Oliver & Oliver 2001b).

*Erica gallorum* L.Bolus is a synonym of *Erica viscaria* L. (Oliver & Oliver 2002a).

*Erica gilva* J.C.Wendl. is a synonym of *Erica mammosa* L. (Oliver & Oliver 2002a).

*Erica grandiflora* L.f. is a synonym of *Erica abietina* L. (Oliver & Oliver 2002a).

*Erica humidicola* E.G.H.Oliv. Bushy or lanky shrublet to 1 m. Flowers small, broadly campanulate, shortly hairy, pink. Sept.–Oct. Sandstone seeps, SW (Kogelberg)\* (Oliver & Oliver 2000).

*Erica intermedia* Klotzsch ex Benth. Erect, rigid shrub to 1.2 m. Flowers medium/large, tubular, white or green to yellowish, with far-exserted anthers. Jan.–Dec. Sandstone slopes, LB, SE (Langeberg Mtns at Swellendam to Outeniqua Mtns at George)\* (Oliver & Oliver 2002a).

*Erica jananthus* E.G.H.Oliv. & I.M.Oliv. Compact or loose, single-stemmed shrublet to 15 cm. Flowers small, urceolate, viscid, white. Aug.–Nov. Rocky, S-facing sandstone slopes, KM (Swartberg Mtns: Snyberg)\* (Oliver & Oliver 2004).

*Erica limnophila* E.G.H.Oliv. Sprawling, tangled shrublet to 15 cm. Flowers small/medium, urceolate, thinly hairy, white. Dec. Marshy soils, SW (Du Toitskloof and Wemmershoek Mtns)\* (Oliver & Oliver 2001a).

*Erica lineata* Benth. is a synonym of *Erica plukenetii* L. (Oliver & Oliver 2002a).

*Erica lithophila* E.G.H.Oliv. & I.M.Oliv. Compact brittle shrublet to 20 cm. Flowers medium, urceolate, pink. Aug.–Nov. N-facing sandstone crevices, KM (Swartberg and Kammanassie Mtns)\* (Oliver & Oliver 2002b).

*Erica mariae* Guthrie & Bolus is a synonym of *Erica regia* Bartl. (Oliver & Oliver 2002a).

*Erica onosmiflora* Salisb. is a synonym of *Erica viscaria* L. (Oliver & Oliver 2002a).

*Erica oreotragus* E.G.H.Oliv. Compact shrublet to 40 cm. Flowers small, urceolate with 4 basal bulges, densely hairy, pinkish. Dec.–Mar. Sandstone slopes, KM (Swartberg Mtns)\* (Oliver & Oliver 2001b).

*Erica penduliflora* E.G.H.Oliv. Erect shrublet to 1 m. Flowers large, inflated tubular to urn-shaped, white or green. Apr.–July. Sandy hills and flats, SW, AP (Pearly Beach to Viljoenshof)\* (Oliver & Oliver 2001c).

*Erica petrusiana* E.G.H.Oliv. & I.M.Oliv. Low woody shrublet. Flowers medium, funnel-shaped, sparsely hairy, slightly sticky, dull yellow. Mar. Stony shale band and sandstone, SW (Kogelberg Mtns)\* (Oliver & Oliver 2002a).

*Erica phyllifolia* Salisb. is a synonym of *Erica abietina* L. (Oliver & Oliver 2002a).

*Erica pilaarkopensis* H.A.Baker not *E. pillarkopensis* H.A.Baker (Oliver 2004).

*Erica porteri* Compton is a synonym of *Erica thomae* L.Bolus (Oliver & Oliver 2002a).

*Erica primulina* (Bolus) E.G.H.Oliv. & I.M. Oliv. is a synonym of *Erica viridiflora* Andrews (Oliver & Oliver 2002a).

*Erica richardii* E.G.H.Oliv. Prostrate to erect shrublet to 30 cm. Flowers small, globose-urceolate, white, shortly hairy. May–July. Crevices in N-facing quartzite outcrops, KM (Grootswartberg: Witberg)\* (Oliver & Oliver 2001a).

*Erica rimarum* E.G.H.Oliv. Compact gnarled shrublet to 10 cm. Flowers small, campanulate, leathery, maroon. Oct.–Dec. S-facing sandstone cliffs, NW, SW (Hex River and Du Toitskloof Mtns)\* (Oliver & Oliver 2000).

*Erica rusticula* E.G.H.Oliv. Compact shrublet to 30 cm. Flowers small, widely funnel-shaped, pink. Apr.–May. Sandy flats, NW (Cold Bokkeveld)\* (Oliver & Oliver 2000).

*Erica salicina* E.G.H.Oliv. (= *E. viminalis* E.G.H.Oliv.) Willowy shrub to 1.5 m. Flowers small, ovoid, white. Jan. Moist, sheltered sandstone cliffs, NW (Hex River Mtns: Milner Peak)\* (Oliver & Oliver 2001a; Oliver 2004).

*Erica schelpeorum* E.G.H.Oliv. & I.M.Oliv. Erect twiggy shrublet to 1.5 m. Flowers small, globose-urceolate, pink. Mainly May–Jul.

Dry enosterveld, KM (Swartberg and Kammanassie Mtns)\* (Oliver & Oliver 2002b).

*Erica taylorii* E.G.H.Oliv. Prostrate shrublet to 20 cm. Flowers medium, ovoid-urceolate, finely hairy or smooth, pink. Oct.–Dec. Sandstone slopes at high alt., NW, KM (Cederberg, Swartberg Mtns)\* (Oliver & Oliver 2001b).

*Erica tenax* L.Bolus is a synonym of *Erica thomae* L.Bolus (Oliver & Oliver 2002a).

*Erica tragomontana* R.C.Turner Erect, single-stemmed shrublet to 35 cm. Flowers broadly funnel-shaped, pink. Sep.–Nov. S-facing quartzite slopes, NM (Cold Bokkeveld)\* (Turner & Oliver 2004).

*Erica umbratica* E.G.H.Oliv. & I.M.Oliv. Delicate brittle shrublet to 50 cm with drooping branches. Flowers urceolate, white, sticky. Jan.–Dec. Moist southern slopes, KM (Swartberg Mtns: Meiringspoort)\* (Oliver & Oliver 2002b).

Current total: genera 1; species 667 (previously 1 genus; 658 species).

## EUPHORBIACEAE

*Hyaenanche globosa* (Gaertn.). Lamb. & Vahl has been removed to Picrodendraceae.

Current total: genera 11; species 79 (previously 12 genera; 80 species).

## FABACEAE

*Aspalathus albens* L. NW, SW (Namaqualand: near Hondeklipbaai to Cape Peninsula). Revised range, not endemic.

*Aspalathus hispida* Thunb. NW, SW, AP, LB, SE (Namaqualand near Springbok, Gifberg to Alexandria). Revised range.

*Aspalathus spinescens* Thunb. NW, SW (Namaqualand: near Hondeklipbaai to Malmesbury). Revised range, not endemic.

*Melolobium lampolobium* (E.Mey.) A.Moteetee & B.-E.van Wyk Rigid, thorny, scarcely glandular shrublet to 60 cm, with brown-velvety stems. Leaves 3-foliolate, leaflets oblanceolate. Flowers many along the thorns, yellow, fading reddish orange. Pods falcate, shining. May–Jan. Karroid scrub, 900–1 530 m, SW, KM (Robertson Karoo and Little Karoo mountains)\* (Moteetee & Van Wyk 2001).

*Podalyria myrtillofolia* (Retz.) Willd. is the current name for *P. cuneifolia* Vent. (Campbell & Van Wyk 2001).

*Psoralea glaucescens* Eckl. & Zeyh. NW (Richtersveld, Kamiesberg to Bokkeveld Mtns). Revised range, not endemic.

*Rafnia perfoliata* (L.) Willd. is the current name for *R. acuminata* (E.Mey.) G.J.Campbell & B.-E.van Wyk (Campbell & Van Wyk 2001).

*Wiborgia obcordata* (P.J.Bergius) Thunb. NW, SW, LB (Namaqualand: near Port Nolloth, and Bokkeveld Mtns to Mossel Bay). Revised range, not endemic.

Current total: genera 37; species 761 (previously 37 genus; 760 species).

## GENTIANACEAE

*Sebaea amicornum* I.M.Oliv. & Beyers Annual to 50 cm. Leaves narrowly lanceolate. Flowers 4-lobed, yellow, calyx lobes slightly keeled, corolla tube shorter than lobes, ± 4 mm long. Oct.–Dec. Sheltered S-facing sandstone ledges, KM, SE (Klein Swartberg, Great Winterhoek Mtns)\* (Oliver & Beyers 2001).

*Sebaea albens* (L.f.) Sm. (not (L.f.) Roem. & Schult.) (Mabberley 1980: 605).

*Sebaea aurea* (L.f.) Sm. (not (L.f.) Roem. & Schult.) (Mabberley 1980: 605).

Current total: genera 3; species 32 (previously 3 genera; 31 species).

## GERANIACEAE

*Pelargonium senecioides* L'Hér. NW, SW, KM (Namaqualand to Cape Peninsula and Witteberg). Revised range, not endemic.

## HYACINTHACEAE

*Albuca* L. is now included in *Ornithogalum*; the 27 new combinations in *Ornithogalum* resulting from this action are listed by Manning *et al.* (2004).

*Daubenya zeyheri* (Kunth) J.C.Manning & Goldblatt Bulbous geophyte to 10 cm. Leaves prostrate, shiny green, bracts small to 10 mm. Flowers clustered between leaves, tubular below, white, filaments orange with purple base. May–June. Coastal limestone flats, NW (Paternoster to Saldanha)\* This species was incorrectly identified as *Daubenya angustifolia* (L.f.) A.M.van der Merwe & J.C.Manning.



- Dipcadi* Medik. is now included in *Ornithogalum* (Manning *et al.* 2004).
- Drimia barkeri*** Oberm. ex J.C.Manning & Goldblatt is a new species for *Drimia* sp. 1 (Manning & Goldblatt 2003).
- Drimia ciliata*** (L.f.) J.C.Manning & Goldblatt is the correct name for *D. ciliata* (L.f.) Baker (Manning & Goldblatt 2003).
- Drimia fragrans*** (Jacq.) J.C.Manning & Goldblatt NW (Namaqualand: Hondeklipbaai, and Bokkeveld Mtns to Hex River Valley). Revised range, not endemic.
- Drimia hesperantha*** J.C.Manning & Goldblatt is the correct name for *Drimia revoluta* (A.V.Duthie) J.C.Manning & Goldblatt (Manning *et al.* 2004).
- Lachenalia corymbosa*** (L.) J.C.Manning & Goldblatt is a new combination for *Polyxena corymbosa* (L.) Jessop. (Manning *et al.* 2004).
- Lachenalia ensifolia*** (Thunb.) J.C.Manning & Goldblatt is a new combination for *Polyxena ensifolia* (Thunb.) Schönk. (Manning *et al.* 2004).
- Lachenalia maughanii*** (W.F.Barker) J.C.Manning & Goldblatt is a new combination for *Polyxena maughanii* W.F.Barker (Manning *et al.* 2004).
- Lachenalia paucifolia*** (W.F.Barker) J.C.Manning & Goldblatt is a new combination for *Polyxena paucifolia* (W.F.Barker) A.M.van der Merwe & J.C.Manning (Manning *et al.* 2004).
- Ledebouria ensifolia*** (Eckl.) S.Venter & T.J.Edwards is a new name for *Ledebouria* sp. 1 of *Cape plants* (Edwards & Venter 2003).
- Massonia bifolia*** (Jacq.) J.C.Manning & Goldblatt is a new combination for *Whiteheadia bifolia* (Jacq.) Baker.
- Massonia grandiflora* Lindl. is now included in *M. depressa* Houtt. (Manning *et al.* 2004).
- Neopatersonia* Schönland is now included in *Ornithogalum* (Manning *et al.* 2004).
- Ornithogalum cirrhulosum*** J.C.Manning & Goldblatt is a new name for *Dipcadi ciliare* (Zeyh. ex Harv.) Baker. (Manning *et al.* 2004).
- Ornithogalum cremnophilum*** (Van Jaarsv. & A.E.van Wyk) J.C.Manning & Goldblatt (= *Albuca cremnophila* Van Jaarsv. & A.E.van Wyk) Pendent, bulbous geophyte to 2 m, bulb usually epigeal, greyish green, scales firm, truncate above. Leaves lanceolate, firm. Flowers erect on long pedicels, subsecund on an inclined peduncle, white with pale greenish keels, inner tepals cowed, outer anthers smaller. Dec.–Feb. Cliffs, SE (Baviaanskloof Mtns).\* (Manning *et al.* 2004).
- Ornithogalum crispum*** (Baker) J.C.Manning & Goldblatt is a new combination for *Dipcadi crispum* Baker (Manning *et al.* 2004).
- Ornithogalum malodorum*** J.C.Manning & Goldblatt is a new name for *Dipcadi brevifolium* (Thunb.) Fourc. (Manning *et al.* 2004).
- Ornithogalum thermarum*** (Van Jaarsv. & A.E.van Wyk) J.C.Manning & Goldblatt (= *Albuca thermarum* Van Jaarsv. & A.E.van Wyk) Like *O. cremnophilum* but leaf bases persistent and fibrous. Nov.–Dec. Sandstone cliffs, KM (Calitzdorp: Badspoor).\* (Manning *et al.* 2004).
- Ornithogalum uitenhagense*** (Schonl.) J.C.Manning & Goldblatt is a new combination for *Neopatersonia uitenhagensis* Schönland (Manning *et al.* 2004).
- Ornithogalum viride*** (L.) J.C.Manning & Goldblatt is a new name for *Dipcadi viride* (L.) Moench. (Manning *et al.* 2004).
- Polyxena* Kunth is now included in *Lachenalia* (Manning *et al.* 2004).
- Spetaea*** Wetschnig & Pfosser is a new monotypic genus for the species identified as *Scilla plumbea* (Wetschnig & Pfosser 2003).
- Spetaea lachenaliiflora*** Wetschnig & Pfosser is a new name for the species identified as *Scilla plumbea* Lindl. in *Cape Plants* (Wetschnig & Pfosser 2003).
- Whiteheadia* Harv. is now included in *Massonia* (Manning *et al.* 2004).
- Current total: genera 10; species 193 (previously 14 genera; 192 species).
- ## IRIDACEAE
- Aristea capitata*** (L.) Ker Gawl. is the correct name for *A. major* Andrews (Goldblatt *et al.* 2002).
- Aristea bracteata*** Pers. is the correct name for *A. monticola* Goldblatt (Goldblatt *et al.* 2002).
- Aristea macrocarpa*** G.J.Lewis is now a synonym of *A. bakeri* Klatt (Goldblatt *et al.* 2002).
- Aristea nana*** Goldblatt & J.C.Manning Evergreen rhizomatous perennial to 10 cm, with compressed, winged, unbranched flowering stem with the terminal internode elongated. Flower paired in terminal clusters within green spathes, on long pedicels, anthers yellow. Capsules ovoid. Aug.–Sept. Stony sandstone slopes, LB, SE (Robinson's Pass to E Cape) (Goldblatt *et al.* 2005).
- Babiana cuneata*** J.C.Manning & Goldblatt Acaulescent cormous geophyte 0.8–1.5 cm. Leaves abruptly truncate at widest point, loosely pleated, smooth or sparsely hairy. Flowers several in dense spikes at ground level, pale to deep blue, the lower lateral tepals with white spear-shaped markings. Mainly Sept. Rocky sandstone or dolerite slopes and flats, NW (Bokkeveld Mtns to Swartruggens and Western Karoo) (Goldblatt & Manning 2004b).
- Babiana fragrans*** (Jacq.) Goldblatt & J.C.Manning is the correct name for *Babiana disticha* Ker Gawl. (Goldblatt & Manning 2004b).
- Babiana longiflora*** Goldblatt & J.C.Manning Cormous geophyte 1.5–2 cm, with suberect stem. Leaves loosely pleated, softly hairy. Flowers several in an inclined spike, zygomorphic, purple, tube elongate, anthers erect, violet. Aug.–early Sept. Seasonally wet stony flats, NW (Piketberg and Porterville)\* (Goldblatt & Manning 2004b).
- Babiana regia*** (G.J.Lewis) Goldblatt & J.C.Manning Cormous geophyte 0.5–1.2 cm, with stems arching outward. Leaves firm, erect, tightly plicate. Flowers several in an inclined spike, actinomorphic, violet with a deep red centre, anthers erect, pollen brown. Aug.–Sept. Seasonally wet sandy flats, SW (Klipheuwel to Stellenbosch)\* (Goldblatt & Manning 2004b).
- Babiana spiralis*** Baker is the correct name for the plant called *B. fibriata* (Klatt) Baker in *Cape plants* (Goldblatt & Manning 2005).
- Babiana truncata* G.J.Lewis does not occur in the CFR.
- Babiana* sp. 1** (= *Babiana inclinata* Goldblatt & J.C.Manning ined.) Cormous geophyte 1.5–3 cm, with stems arching outward. Leaves firm, erect, tightly plicate. Flowers numerous in an inclined spike, zygomorphic, violet with white and darker blue marks on the lower tepals, dorsal tepal and stamens facing the spike apex. Sept.–Oct. Stony clay flats and lower slopes in renosterveld SW (Piketberg to Paarl).\*
- Babiana* sp. 2** (= *Babiana melanops* Goldblatt & J.C.Manning ined.) Cormous geophyte 1–2 cm, with stems suberect. Leaves erect, lanceolate, softly hairy. Flowers several in an erect spike, actinomorphic, violet to purple with a dark centre, anthers arrow-shaped with wide connective, blackish. Aug.–Sept. Clay slopes in renosterveld, NW, SW (Tulbagh valley to Mamre).\*
- Babiana* sp. 3** (= *Babiana noctiflora* J.C.Manning & Goldblatt ined.) Like *B. odorata* but flowers larger, with a tube 35–50 mm long, narrow at base and wider in the upper 15–25 mm. Sept.–Oct. Rocky outcrops in renosterveld, Paardeberg S of Malmesbury).\*
- Babiana* sp. 4** (= *Babiana papyracea* Goldblatt & J.C.Manning ined.) Cormous geophyte to 1.5 cm, with stems reaching ground level. Leaves firm, linear, erect, tightly plicate. Flowers several in short erect spikes, actinomorphic, purple with a darker centre, anthers erect, pollen cream, floral bracts dry, papery and attenuate. Sept.–Oct. Clay flats, NW (Bokkeveld Plateau).\*
- Babiana* sp. 5** (= *Babiana radiata* Goldblatt & J.C.Manning ined.) Cormous geophyte to 1–1.5 cm, with stems reaching ground level. Leaves firm, linear, erect, softly hairy. Flowers several in short erect spikes, actinomorphic, purple with a red centre and margins often white below, anthers erect, pollen cream. Aug.–Sept. Sandy flats, KM (Little Karoo near De Rust).\*
- Diets grandiflora*** N.E.Br. Evergreen rhizomatous perennial, 30–50 cm. Leaves sword-shaped. Flowers white with violet style arms, outer tepals with yellow marking at limb base and a line of yellow hairs on claws, lasting 2–3 days. Mainly Sept.–Dec. Margins of evergreen thicket, SE (Hankey to KwaZulu-Natal).
- Ferraria divaricata*** Sweet Cormous geophyte to 45 cm, stem reaching well above ground, much-branched above. Leaves sword-shaped, crowded basally. Flowers brown to maroon with lighter brown margins or golden brown with darker margins, claws broad, forming a wide cup, nectaries pale green, large, anther lobes divergent, capsule beaked. Mainly late Sept.–Nov. Deep sands, NW, SW (Hondeklipbaai to Cape Flats). Revised species circumscription and range.
- Ferraria uncinata*** Sweet Flowers blue to violet with brown margins. Aug.–Sept. Mainly sandstone slopes and outcrops, NW, SW (Klawer to Malmesbury)\*. Revised description and range, now endemic (Goldblatt & Manning 2005).
- Ferraria variabilis*** Goldblatt & J.C.Manning Cormous geophyte, 6–20 cm, branching mostly near base. Leaves sword-shaped, crowded at base, sheathing the stem. Flowers dull yellow, yellow-green or brown, with banded or speckled markings and darker margins, often putrid-smelling, claws broad, forming a wide cup, nectaries basal, dark-coloured, anther lobes diverging, capsule beaked. Aug.–Nov. Sandy and shale flats and rock outcrops, NW, SW, KM, LB (S Namibia to Clanwilliam, Caledon to Little Karoo) (Goldblatt & Manning 2005).
- Freesia fucata*** J.C.Manning & Goldblatt Cormous geophyte, 15–30 cm. Leaves linear, glaucous. Flowers white flushed mauve on reverse, sweetly scented, bracts tricuspidate. July. Renosterveld, SW (Bosjesveld between Villiersdorp and Breede River)\* (Manning & Goldblatt 2001a).



**Freesia** sp. 1 (= *Freesia marginata* J.C.Manning & Goldblatt ined.) Like **F. caryophyllacea** but leaves leathery with thickened submarginal veins. May–June. Gravelly washes in succulent karoo, SW (Robertson Karoo).\*

**Freesia** sp. 2 (= *Freesia praecox* J.C.Manning & Goldblatt ined.) Like **Freesia alba** but stems mostly unbranched and without axillary cormels. June–July. Rocky sandstone slopes, SW (Riviersonderend Mtns).\*

**Gladiolus wilsonii** (Baker) Goldblatt & J.C.Manning Cormous geophyte, 30–50 cm, tunics fibrous. Leaves linear, whip-like. Flowers in slender spikes, short-tubed, bilabiate, white or flushed lilac. Oct.–Nov. Open grassland, SE (Humansdorp to E Cape). Range extension, new for the flora.

**Hesperantha cilolata** Goldblatt Like **H. pilosa** but leaves terete or oval in section with four to several deep grooves, scabrid-ciliate in the rib edges, and flowers violet, musk-scented. Aug.–Sept. Stony sandstone slopes, KM (Voetpadsdorp (Touwsrivier) and Roggeveld Escarpment) (Goldblatt 2003).

**Hesperantha malvina** Goldblatt Like **H. pilosa** but leaves sparsely long-hairy, and flowers pale mauve, larger with tepals  $\pm 14 \times 4$ –5 mm. Sandstone cliffs, KM (Little Karoo: Anysberg)\* (Goldblatt 2003).

**Hesperantha sufflava** Goldblatt Like **H. falcata** but leaves always 3, crowded at base, flowers pale yellow and perianth tube 12–16 mm long, exceeding tepals. Late July–Aug. Sandy gravel slopes in renosterveld, SW (Malmesbury)\* (Goldblatt 2003).

**Ixia atrandra** Goldblatt & J.C.Manning Cormous geophyte to 50 cm. Leaves narrowly lanceolate, usually four, stem 1- or 2-branched. Flowers crowded in a dense spike, pink or cream-coloured with a large dark centre, tube filiform, stamens fully exerted, blackish, anthers broad, arrow-shaped with exposed connective. Sept.–Oct. Renosterveld, SW (Bosjesveld between Villiersdorp and the Breede River)\* (Manning & Goldblatt 2001a).

**Ixia superba** J.C.Manning & Goldblatt Cormous geophyte to 60 cm. Leaves lanceolate, twisted. Flowers crowded in a dense 3–6-flowered spike, salver-shaped, pale to deep pink, purple to blackish in the centre, lightly scented, tube filiform below, stamens blackish, anthers linear. Aug.–Sept. Loamy lower slopes, KM (Little Karoo, Montagu)\* (Goldblatt & Manning 2004a).

**Moraea cantharophila** Goldblatt & J.C.Manning Like **M. lurida** but flowers always cream, tepals claws shorter, forming a shallow cup, and anthers partly exerted from floral cup, not foul-scented. Aug.–Sept. Loamy clay and shale bands, SW (Sir Lowry's Pass to Sandy's Glen)\* (Goldblatt & Manning 2002b).

**Moraea lilacina** Goldblatt & J.C.Manning is a new species for *Moraea* sp. 1 (Goldblatt & Manning 2002b).

**Moraea minuta** Goldblatt is the correct name for *M. minutiflora* Goldblatt.

**Moraea monticola** Goldblatt is the correct name for *M. obscura* Goldblatt.

*Moraea neopavonia* R.C.Foster is now a synonym of **M. tulbaghensis** L.Bolus (Goldblatt & Manning 2002b).

**Moraea regalis** Goldblatt & J.C.Manning is the correct name for *M. derustensis* Goldblatt & J.C.Manning *nom. nud.*

**Moraea simplex** Goldblatt & J.C.Manning Like **M. elsiae** but foliage leaf solitary, flowers pale yellow, and style branches undivided, filiform, extending between bases of anthers. Sept.–Oct. Gritty sandy flats, NW (eastern foot of the Piketberg Mtns)\* (Goldblatt & Manning 2004a).

**Romulea discifera** J.C.Manning & Goldblatt Cormous geophyte, 10–20 cm, with symmetrical, depressed bell-shaped corm, lower margins forming a spreading ridge, stem branching above ground. Leaves 3–5. Flowers cup-shaped, bright yellow with a darker yellow cup. Mid July–early Aug. Sandy flats, NW (Bokkeveld Plateau)\* (Manning & Goldblatt 2001b).

**Romulea lilacina** J.C.Manning & Goldblatt Cormous geophyte, 1–3 cm, corms rounded at base. Basal leaf solitary, sticky with adhering sand grains. Flowers solitary, lilac with darker stripes in a pale cup. Ripe capsules recurved. May–June. Deep sands in washes, NW (Cold Bokkeveld: Katbakkies)\* (Manning & Goldblatt 2001b).

*Romulea papyracea* Wolley-Dod is now a synonym of **R. schlechteri** Bég. (Manning & Goldblatt 2001b).

**Thereianthus montanus** J.C.Manning & Goldblatt is a new name for *Thereianthus* sp. 1 of *Cape plants* (Manning & Goldblatt 2004).

**Tritoniopsis bicolor** J.C.Manning & Goldblatt Like **T. parviflora** but leaves narrowly lanceolate, pseudopetiolate, and filaments shorter, 6–7 mm long. Dec. Seasonally waterlogged sandstone plateau, SW (Bredasdorp Mtns)\* (Manning & Goldblatt 2001c).

**Tritoniopsis flava** J.C.Manning & Goldblatt Like **T. parviflora** but more robust with lanceolate leaves, 2- or 3-veined and flowers yellow.

low. Dec. Seasonal marshes, SW (Kogelberg Reserve near Palmiet River mouth)\* (Manning & Goldblatt 2001c).

**Tritoniopsis toximontana** J.C.Manning & Goldblatt Cormous geophyte, 30–65 cm. Leaves lanceolate, 3-veined, pseudopetiolate. Flowers pink, tube elongate, to 20 mm long. March–May. Sandstone outcrops, NW (Gifberg and Matsikamma Mtns)\* (Manning & Goldblatt 2001c).

Current total: genera 28; species 684 (previously 28 genera; 663 species).

## ISOETACEAE

**Isoetes toximontana** L.J.Musselman & J.P.Roux Tufted geophyte, rootstock 3-sided, with horny tricuspidate scales. Sporophylls 3–10, to 42 mm long. Sporangium lacking velum. Megaspores grey-green. Seasonal pools and seepage areas, 300–560 m, NW (Gifberg and Cederberg Mtns)\* (Musselman & Roux 2002).

Current total: genera 1; species 3 (previously 1 genus; 2 species).

## LOGANIACEAE

*Nuxia* Comm. ex Lam. with *N. floribunda* Benth. has been removed to Stilbaceae.

Current total: genera 1; species 2 (previously 2 genera; 3 species).

## MARSILEACEAE

**Pilularia americana** A.Braun Minute herb, rhizome creeping, branched. Leaves simple, terete, to 19 mm long. Sporocarps globose, to 2.5 mm diam., densely haired. Rim of ephemeral pools, NW (Bokkeveld Plateau and N and S America) (Roux 2002).

Current total: genera 2; species 5 (previously 1 genus; 4 species).

## MENYANTHACEAE

**Villarsia manningiana** Ornduff Like **V. capensis** but usually smaller. Leaf blades up to 50 mm long. Sept.–Dec. Peaty soils and stream margins (SW, SE: Cape Peninsula to Hermanus and Outeniqua Mtns at Knysna)\* (Ornduff 2001).

Current total: genera 1; species 3 (previously 1 genus; 2 species).

## ONAGRACEAE

**Ludwigia octovalvis** (Jacq.) P.H.Raven Softly woody shrub to 4 m, shortly hairy on branches. Leaves linear to lanceolate. Flowers solitary in upper axils, yellow, sepals 4. Oct.–Jan. Wet places and river banks, NW (pantropical but probably naturalized in the Olifants River Valley)!

Current total: genera 1; species 2 (previously 1 genus; 2 species).

## PICRODENDRACEAE

**Hyaenanche globosa** (Gaertn.) Lamb. & Vahl (not (Gaertn.) Lam.), transferred from Euphorbiaceae.

Current total: genera 1; species 1 (not previously recognized in the flora).

## PLANTAGINACEAE

**Ilysanthes dubia** (L.) Bernh., transferred from Scrophulariaceae.

**Limosella africana** Glück, transferred from Scrophulariaceae.

**Limosella grandiflora** Benth., transferred from Scrophulariaceae.

Current total: genera 3; species 6 (previously 1 genus; 3 species).

## POACEAE

**Agrostis polypogonoides** Stapf (not *A. polygonoides* Stapf).

**Cenchrus incertus** M.A.Curtis (not *C. incertus* M.A.Curtis).

**Chaetobromus involucreatus** (Schrad.) Nees (= *C. dregeanus* Nees).

**Cymbopogon nardus** (L.) Rendle (= *C. validus* (Stapf) Stapf ex Burtt Davy).

**Cymbopogon pospischilii** (K.Schum.) C.E.Hubb. (= *C. plurinodis* (Stapf) Stapf ex Burtt Davy).

**Digitaria scalarum** (Schweinf.) Chiov. (= *D. abyssinica* of authors not *D. abyssinica* (A.Rich.) Stapf, missapplied name).

**Eragrostis mexicana** (Hornem.) Link (= *E. virescens* J.Presl. & C.Presl.).

**Hordeum geniculatum** All. (= *H. marinum* Huds.).

**Leptochloa fusca** (L.) Kunth (= *Diplachne fusca* (L.) P.Beauv. ex Roem. & Schult.).

**Miscanthus ecklonii** (Nees) Mabb. is the correct name for *M. capensis* (Nees) Andersson (Mabberley 1984: 442).

**Pentascistis heptamera** (Nees) Stapf Perennial to 30 cm. Leaves basal, linear. Spikelets 5–6 mm long, in a dense panicle, lemmas 5–9-awned. Nov.–Dec. Coastal sands, SE (Humansdorp to East London).

Current total: genera 61; species 208 (previously 61 genera; 207 species).

#### POLYGALACEAE

**Muraltia bondii** Vlok Erect, single-stemmed, closely leafy shrublet to 50 cm. Leaves subsessile, linear-lanceolate and semi-terete, mucronate. Flowers solitary in axils, white tipped purple. Aug.–Nov. Rocky sandstone slopes, KM (Little Karoo, Anysberg).\*

Current total: genera 3; species 142 (previously 3 genera; 141 species).

#### RESTIONACEAE

**Ceratocaryum caespitosum** H.P.Linder Dioecious, caespitose perennial to 1 m, culms simple. Nuts to 10 mm long, tuberculate at apex. Nov. Sandstone slopes, 100–200 m, SW (False Bay to Hermanus)\* (Linder 2001a).

**Ceratocaryum persistens** H.P.Linder Dioecious, spreading perennial to 1.5 m, culms simple. Nuts to 10 mm long, smooth. Mar.–Apr. Sandstone slopes, 300–500 m, SW (Hottentots Holland Mtns)\* (Linder 2001a).

**Ischyrolepis gaudichaudiana** (Kunth) H.P.Linder NW, SW, AP, KM, LB (Namaqualand to Uniondale). Revised range, not endemic (Linder 2001b).

Current total: genera 19; species 320 (previously 19 genera; 318 species).

#### RHAMNACEAE

**Noltea africana** (L.) Endl. (not (L.) Rchb.f.).

#### ROSACEAE

**Cliffortia ruscifolia** L. NW, SW, KM, LB, SE (Richtersveld to Humansdorp). Revised range, not endemic.

#### SAPINDACEAE

**Dodonaea viscosa** Jacq. (= *Dodonaea angustifolia* L.f.).

#### SCROPHULARIACEAE

**Buddleja** L. with **B. glomerata** H.L.Wendl., **B. saligna** Willd., and **B. salvifolia** (L.) Lam. moved here from Buddlejaceae.

**Freylinia helmei** Van Jaarsv. Erect slender resprouting shrub to 2.5 m. Leaves narrowly elliptic, 20–30 mm long. Flowers in short racemes, subpendulous, tubular, white to mauve, 25–27 mm long, stamens unequal, style over half as long, 15–17 mm long. Oct.–Nov. Steep shale slopes in renosterveld, SW (Botrivier)\* (Van Jaarsveld & Thomas 2003).

**Gomphostigma** Turcz. is added to the flora.

**Gomphostigma virgatum** (L.f.) Baill. Slender, willowy, closely leafy shrublet to 1 m. Leaves opposite, linear, usually greyish. Flowers in long narrow racemes, white, scented, tube subcampanulate, 2–4 mm long, tepals spreading. Nov.–Sept. Along watercourses in running water among boulders, NW, KM (Namaqualand, Bokkeveld and Swartberg Mtns, Namibia and Zimbabwe).

**Halleria**, with **H. elliptica** Thunb., **H. lucida** L., and **H. ovata** Benth., removed to Stilbaceae.

**Ilysanthes**, with **I. dubia** (L.) Bernh., removed to Plantaginaceae.

**Ixianthes**, with **I. retzioides** Benth., removed to Stilbaceae.

**Limosella**, with **L. africana** Glück and **L. grandiflora** Benth., removed to Plantaginaceae.

**Nemesia cheiranthus** E.Mey. ex Benth. NW (Namaqualand: Komaggas, and Bokkeveld Mtns to Piketberg). Revised range, not endemic.

**Selago gloioides** Hilliard is the correct name for *Selago gliodes* Hilliard (Hilliard 1999).

**Selago subspinosa** Hilliard KM (W Little Karoo and Roggeveld Escarpment). Revised range, not endemic (Hilliard 1999).

Current total: genera 31; species 408 (previously 33 genera; 411 species).

#### SOLANACEAE

**Lycium strandveldense** A.M.Venter Dioecious thorny shrub to 1.5 m. Leaves densely fascicled on short branches, succulent, narrowly ovate or obovate. Flowers solitary, from centre of leaf clusters, actinomorphic, tubular, deep purple, male flowers with fertile sta-

mens and vestigial style lacking a stigma, female flowers with long style, anthers lacking pollen. Sept.–Dec. Sandy flats and dunes, NW (Namaqualand to Veldrif) (Venter & Venter 2003).

Current total: genera 2; species 19 (previously 2 genera; 18 species).

#### STILBACEAE

**Halleria elliptica** Thunb., transferred from Scrophulariaceae.

**Halleria lucida** L., transferred from Scrophulariaceae.

**Halleria ovata** Benth., transferred from Scrophulariaceae.

**Ixianthes retzioides** Benth., transferred from Scrophulariaceae.

**Nuxia floribunda** Benth., transferred from Loganiaceae.

Current total: genera 9; species 19 (previously 6 genera; 14 species).

#### TAMARICACEAE

**Tamarix usneoides** E.Mey. ex Bunge Willowy tree with slender, drooping branches, to 9 m. Leaves scale-like. Flowers in massed panicles, minute, pink to grey. Mainly Mar.–June. Stream banks or dry river courses, KM (Little Karoo to Great Karoo and E Cape).

Current total: genera 1; species 1 (not previously included in *Cape plants*).

#### THYMELAEACEAE

**Gnidia denudata** Lindl. ?KM, LB, SE (Touws River and Langeberg Mtns to Mozambique: Inhaca Island). Revised range, not endemic (Edwards, Beaumont & Styles 2001).

**Passerina comosa** C.H.Wright NW, SW, KM, LB (Kamiesberg, W Karoo, and Cold Bokkeveld to Klein Swartberg Mtns). Revised distribution.

**Passerina esterhuyseniae** Bredenk. & A.E.van Wyk Like **P. comosa** but bracts helmet-shaped, brownish, and pale yellow flowers turning red to brown after pollen release. Flowering time? High rocky slopes and peaks (NW: Pakhuis Mtns and Redelinghuys)\* (Bredenkamp & Van Wyk 2003).

**Passerina falcifolia** (Meisn.) C.H.Wright SW, KM, LB, SE (Caledon District and Outeniqua Mtns to Alexandria), revised range, not endemic.

**Passerina filiformis** L. NW, SW, LB (Clanwilliam to Peninsula, Hex River Mtns to Langeberg at Attaquaskloof).\* Revised distribution.

**Passerina montevaga** Bredenkamp & A.E.van Wyk Like **P. filiformis** but leaves below flowers swollen at the base. Flowering time? Rocky slopes, LB, SE (Mossel Bay to N Tanzania) (Bredenkamp & Van Wyk 2002c).

**Passerina nivicola** Bredenkamp & A.E.van Wyk NW (Cold Bokkeveld and W Karoo) Revised range. (Bredenkamp & Van Wyk 2002a).

**Passerina quadrifaria** Bredenkamp & A.E.van Wyk Like **P. comosa** but leaves less hairy. Flowering time? Rocky sandstone slopes at high alt., LB, KM, SE (Langeberg and Little Karoo mountains to Great Winterhoek Mtns)\* (Bredenkamp & Van Wyk 2002b).

**Passerina truncata** (Meisn.) Bredenkamp & A.E.van Wyk is the correct name for *Passerina glomerata* Thunb. and the distribution is corrected to NW, SW, KM, LB, SE (Namaqualand and Bokkeveld Mtns to Baviaanskloof) (Bredenkamp & Van Wyk 2003).

Current total: genera 4; species 127 (previously 4 genera; 124 species).

#### ZYGOPHYLLACEAE

**Roepera cordifolia** (L.f.) Beier & Thulin (= *Zygophyllum cordifolium* L.f.).

**Roepera cuneifolia** (Eckl. & Zeyh.) Beier & Thulin (= *Zygophyllum cuneifolium* Eckl. & Zeyh.).

**Roepera debilis** (Cham. & Schltdl.) Beier & Thulin (= *Zygophyllum debile* Cham. & Schltdl.).

**Roepera flexuosa** (Eckl. & Zeyh.) Beier & Thulin (= *Zygophyllum flexuosum* Eckl. & Zeyh.).

**Roepera foetida** (Schrad. & J.C.Wendl.) Beier & Thulin (= *Zygophyllum foetidum* Schrad. & J.C.Wendl.).

**Roepera fulva** (L.) Beier & Thulin (= *Zygophyllum fulvum* L.).

**Roepera fuscata** (Van Zyl) Beier & Thulin (= *Zygophyllum fuscatum* Van Zyl).

**Roepera lichtensteiniana** (Cham. & Schltdl.) Beier & Thulin (= *Zygophyllum lichtensteinianum* Cham. & Schltdl.).

**Roepera maculata** (Aiton) Beier & Thulin (= *Zygophyllum maculatum* Aiton).

**Roepera maritima** (Eckl. & Zeyh.) Beier & Thulin (incl. *Zygophyllum uitenhagense* Sond.).

**Roepera morgsana** (L.) Beier & Thulin (= *Zygophyllum morgsana* L.).  
**Roepera pygmaea** (Eckl. & Zeyh.) Beier & Thulin (= *Zygophyllum pygmaeum* Eckl. & Zeyh.).  
**Roepera rogersii** (Compton) Beier & Thulin (= *Zygophyllum rogersii* Compton).  
**Roepera sessilifolia** (L.) Beier & Thulin (= *Zygophyllum sessilifolium* L.).  
**Roepera spinosa** (L.) Beier & Thulin (= *Zygophyllum spinosum* L.; incl. *Z. procumbens* Adamson) NW, SW (Namaqualand: near Kleinsee, and Lambert's Bay to Cape Peninsula) Revised range, not endemic. (Van Zyl 2000).  
The undescribed species of *Zygophyllum* listed in *Cape plants* should also be included in **Roepera**.  
**Tetraena retrofracta** (Thunb.) Beier & Thulin (= *Zygophyllum retrofractum* Thunb.).  
Current total: genera 5; species 22 (previously 4 genera; 23 species).

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## *Commiphora kaokoensis* (Burseraceae), a new species from Namibia, with notes on *C. dinteri* and *C. namaensis*

W. SWANEPOEL\*

**Keywords:** Burseraceae, *Commiphora* Jacq., endemism, Kaokoveld, morphology, Namibia, new species, taxonomy

### ABSTRACT

*Commiphora kaokoensis* W.Swanepoel, here described as a new species, is known only from the Kaokoveld Centre of Endemism, an arid region in northwestern Namibia. Illustrations of the plant and a distribution map are provided. Diagnostic characters include the petiolate or subsessile, all-simple and relatively large leaves with the lamina obovate or elliptic. New information is provided on the leaf morphology and geographical distribution of *C. namaensis* Schinz and *C. dinteri* Engl., species with which the new species shares some similarities. When without leaves or fruit, the three species can easily be confused. A comprehensive table with diagnostic morphological features to distinguish between the three species is presented.

### INTRODUCTION

A new species, *Commiphora kaokoensis* W.Swanepoel, is described. Apart from one specimen (*Giess 9427* in WIND) collected in 1966, the new species remained uncollected until recently. This can be attributed to its limited range in remote parts of the Kaokoveld, northwestern Namibia. In addition, when without leaves or fruit, the plants are virtually indistinguishable from *C. namaensis* Schinz (Van der Walt 1973) and *C. dinteri* Engl. (Van der Walt 1974), species for which it could have been mistaken in the past.

New information is provided on the leaf characteristics of *C. namaensis* and *C. dinteri*. Diagnostic morphological features to differentiate between these two species and *C. kaokoensis* are presented. Previous misidentifications of *C. dinteri* are corrected and apparently wrongly indicated localities, including quarter-degree grids, of two herbarium specimens are rectified.

Apart from examining the herbarium collections of *C. kaokoensis*, *C. dinteri* and *C. namaensis* in WIND and PRE, numerous populations of the three species were studied all over their respective ranges in Namibia during two years of extensive field work. Morphological characters were all determined from fresh material.

1. *Commiphora kaokoensis* W.Swanepoel, sp. nov., *C. namaensis* Schinz habitu foliisque simplicibus similis sed cortice in ramis caulibusque senioribus plerumque longitudinaliter subcristato, foliis semper simplicibus, plerumque maioribus, obovatis vel ellipticis, margine plerumque crenato-serrato cum dentibus pluribus usque ad duplo numero, raro subintegro, petiolatis vel subsessilibus; petiolo elliptico vel lunato, in sectione transversali maiore; floribus minoribus, solitariis vel fasciculatis, parte distali loborum disci non ad hypanthium adnata, in floribus masculis lobis distincte bifidis, filamentis staminum infra plerumque nec applanatis nec incrassatis; fructu ovoideo, ellipsoideo vel obovoideo,

loculo fertili saepe ad loculum sterilem flexo, apiculato, plerumque maiori, exocarpio valde glutinoso; angulo inter loculos in apice putaminis plerumque valde minori, putaminis sutura loculum fertilem versus convexa, loculo sterili aspectu suturali variabili, subconcavo, paene plano, triangulari, convexo vel e basi convexo ad concavum apicem versus varianti; brachiis commissurae pseudarilli plerumque longioribus, aliquando putaminis apicem attingentes, differt.

TYPE.—Namibia, 1913 (Sesfontein): Kharokhaobvakte, (–BC), 1 030 m, 10-05-2002, *Swanepoel 1* (WIND, holo.!, PRE, iso.!).

Illustrations: Steyn: 43, 44 & 87 (2003).

Diocious, shrub-like tree, 0.3–3.0 m tall, 0.3–6.5 m diam. *Trunk* branching repeatedly just above or below soil level into many stems, rarely with a single trunk up to 200 mm high, up to 180 mm diam.; stems relatively thick, with many thinner side branches (Figure 1). *Bark* pale grey to reddish grey or yellowish cream to brown with small, dark spots, with slightly raised, almost parallel longitudinal ridges on stems and older branches, not peeling, trunk rarely corky and irregularly cracked from soil level up to 150 mm. *Branches and branchlets* glabrous with scattered small lenticels, not spine-tipped; branchlets relatively short, stout, often scarred (Figure 2). *Exudate* milky, glutinous, aromatic, producing a hard, colourless to pale greenish transparent resin, often cracked or disintegrated into small glass-like pieces. *Leaves* simple, clustered on dwarf lateral branchlets, spirally on shoots, glabrous, green; lamina obovate to broadly obovate or elliptic to broadly elliptic, (6–)15–34(–58) × (4–)12–20(–32) mm, apex obtuse, retuse or truncate, base cuneate or cuneate and abruptly attenuate onto the petiole, rarely obtuse; margin finely crenate-serrate or rarely serrate-dentate with (7–)14–20(–25) teeth on each side, rarely subentire, entire near base; midrib yellowish green, conspicuous abaxially towards lamina base, prominently raised ab- and adaxially, especially towards lamina base (Figure 3); petiolate or subsessile, petiole from less than 1 mm up to 21 mm long, elliptic to crescent-shaped in t/s with 5–12 vascular bundles, dimensions in t/s (0.8–)1.1–1.6(–1.9) × (0.7–)1.0–1.2(–1.4) mm.

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FIGURE 1.—*C. kaokoensis* in its natural habitat,  $\pm 1.2$  m tall.

**Inflorescence:** flowers borne in clusters or solitary, axillary. **Flowers** sessile or subsessile, unisexual, perigynous, appearing before or with leaves or occasionally flowering continuously until leaves have been shed. **Bracteoles** ovate, apex acute, glandular, up to 1.2 mm long. **Calyx** green to maroon or cherry, continuous with hypanthium, usually sparsely glandular otherwise glabrous; lobes ovate to triangular, apex acute. **Petals** greenish yellow to yellow, glabrous, narrowly elliptic to oblanceolate, recurved towards apex, but minute tip inflexed, inserted on hypanthium. **Disk** cylindrical with 4 fleshy lobes, adnate to hypanthium but distal part of lobes free. **Male flowers** 2.8–4.9 mm long; calyx 1.6–3.4 mm long, lobes 0.8–1.4 mm long; petals 2.4–4.0 mm long; disk lobes distinctly bifid at apex; stamens 8, 4 long sta-

mens with filaments 1.6–2.8 mm long, inserted on margin of disk lobes, 4 short stamens with filaments 0.8–2.1 mm long, inserted on margin of disk between lobes; anthers 0.7–1.0 mm long, equal in length on short and long stamens; filaments subterete, rarely flattened and broadened over lower part; gynoecium rudimentary (Figure 4A–C). **Female flowers** 2.0–2.7 mm long; calyx 1.6–2.0 mm long, lobes 0.5–0.9 mm long; petals 1.7–2.5 mm long; disk lobes obscurely bifid; staminodes 8, 4 long and 4 short; ovary half inferior, sparsely glandular; style relatively long, sparsely glandular, sutures deeply grooved; stigma obscurely lobed; pistil 1.0–1.6 mm long (Figure 4D–F). **Fruit** a drupe, ovoid, ellipsoid or obovoid, apiculate, flattened, asymmetrical (Figure 5), fertile locule often bent over towards the sterile locule, appearing



FIGURE 2.—*C. kaokoensis*. Close up of branches.

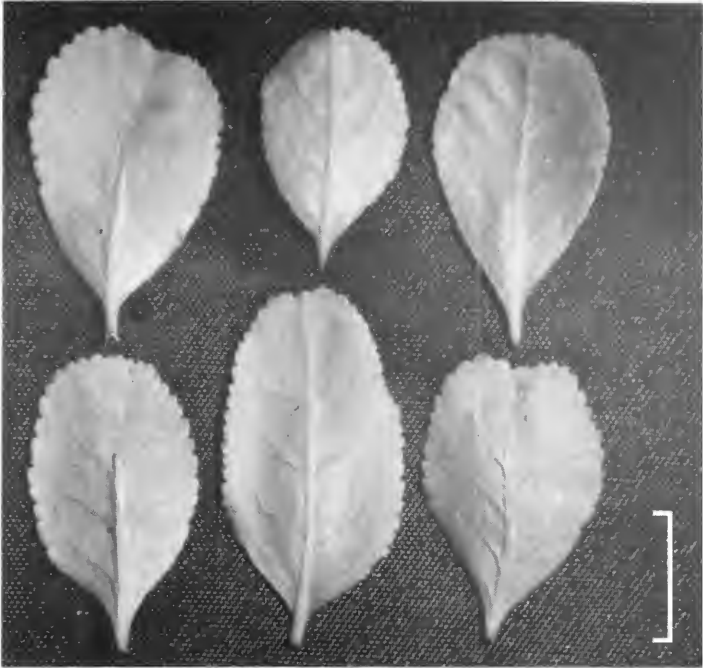


FIGURE 3.—*C. kaokoensis*. Leaves, as seen from below. Scale bar: 10 mm.

slightly falcate in sutural view, 9–13 × 7–8 × 5–7 mm; pericarp 2-valved; exocarp glabrous, glutinous, maroon in ripe fruit; mesocarp not very fleshy; putamen flattened,

asymmetrically ovoid, ellipsoid or rarely subglobose with one fertile and one sterile locule, slightly rugose, 5.0–8.7 × 4.0–5.8 × 3.0–4.2 mm; fertile locule convex in sutural and apical view; sterile locule dorsally ridged, variable in sutural view: either slightly concave, almost flat, triangular, convex or varying from convex at base to concave towards apex, ± triangular in apical view; suture convex towards fertile locule; angle between locules at apex (42°–)53°–73°(–91°); pseudo-aril orange to red, fleshy, cupular, covering (15–)20–25(–34)% of fertile locule and (15–)25–40(–48)% of sterile locule, with 2 commissural arms and 2(1) short facial lobes, extent of commissural arms (relative to length of putamen with pseudo-aril removed) (46–)60–80(–100)%, facial lobes convex or triangular, 0.5–1.1 mm on fertile locule, 0.3–2.1 mm on sterile locule, lobe on fertile locule often undeveloped and completely absent; apical pits small, often absent (Figure 4G–I). *Flowering time*: August to March, occasionally throughout the year. *Pollination*: probably by small ants, often observed on flowers.

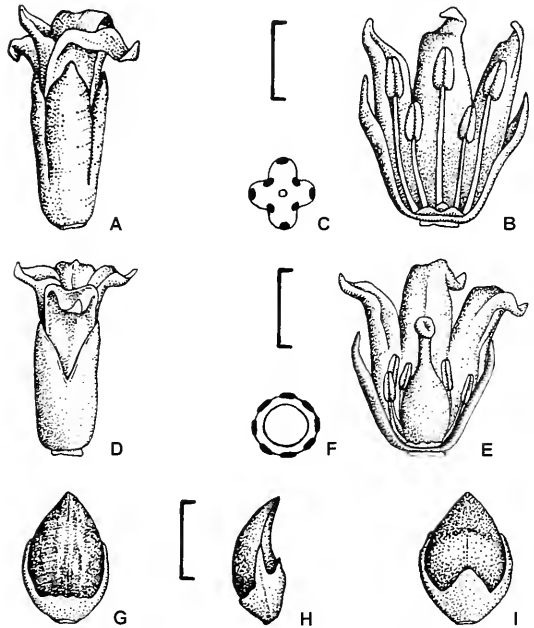


FIGURE 4.—*C. kaokoensis*. A–C, male flower: B, calyx and corolla partly removed; C, disc as seen from above to depict position of stamens (black) and rudimentary ovary (circle). D–F, female flower: E, calyx and corolla partly removed; F, disc as seen from above to depict position of stamens (black). G–I, putamen with pseudo-aril: G, side with fertile locule; H, lateral view, fertile locule (convex side) left, sterile locule (concave side) right; I, side with sterile locule. A, B, Swanepoel 52; D, E, Swanepoel 73; G–I, Swanepoel 1. Scale bars: A, B, D, E, 1 mm; G–I, 5 mm. Artist: Anne Stadler.



FIGURE 5.—*C. kaokoensis*. Dwarf lateral branchlet with leaves and fruit. Scale bar: 10 mm.



**Diagnostic characters and affinities:** *Commiphora kaokoensis* differs from *C. dinteri* and *C. namaensis* mainly in leaf and fruit characters, apart from minor differences in the flowers, as well as in geographical distribution. *C. kaokoensis* can be readily distinguished from these and all other southern African succulent-appearing *Commiphora* species, by its all-simple, relatively large leaves, (6–)15–34(–58) × (4–)12–20(–32) mm, that are petiolate or subsessile, with the lamina obovate or elliptic. The midrib is conspicuous abaxially towards the lamina base and prominently raised ab- and adaxially, especially towards lamina base. The petiole in t/s is relatively thick, (0.8–)1.1–1.6(–1.9) × (0.7–)1.0–1.2(–1.4) mm, crescent-shaped or elliptic, with 5–12 vascular bundles.

*C. namaensis* also has simple leaves, but rarely develops a few additional trifoliolate leaves. The leaves are rotund, orbicular, ovate or cordate, usually much smaller than in *C. kaokoensis*, (5–)7–12(–15) × (4–)5–11(–14) mm and always petiolate; the midrib is inconspicuous and not, or only slightly raised ab- and adaxially towards the lamina base; the petiole in t/s is smaller, 0.5–0.7 × 0.5–0.7 mm, always crescent-shaped and with 3–7 vascular bundles only.

*C. dinteri* usually has predominantly trifoliolate leaves with a few additional simple leaves. Only rarely, in a few restricted localities, does it either have only simple leaves, or predominantly simple leaves with a few additional trifoliolate leaves, or simple and trifoliolate leaves together in equal numbers on the same plant. Simple leaves in *C. dinteri* are variable in shape, and on individual plants may vary between obovate, elliptic, ovate, cordate, oblate or slightly oblong. Unlike *C. kaokoensis*, the simple leaves of *C. dinteri* are always petiolate, with the lamina usually much smaller, about half the size, (3–)7–18(–27) × (3–)6–15 (–25) mm; the midrib is inconspicuous and not, or only slightly raised, ab- and adaxially towards the lamina base; the petiole in t/s differs from *C. kaokoensis* by being triangular, pentagonal or reniform in shape, usually smaller, 0.7–0.8 × 0.6–0.7 mm, and with only 3–7 vascular bundles. For comparable lamina size, the petioles of both *C. namaensis* and *C. dinteri* are slender when compared to those of *C. kaokoensis*. Petioles of *C. kaokoensis* with t/s dimensions similar to those of *C. namaensis* and *C. dinteri*, are only found on exceptionally small leaves, occasionally present amongst the usually larger leaves.

Additional differences between these three taxa are provided by fruit morphology: the suture of the putamen in *C. kaokoensis* is convex towards the fertile locule and the angle between locules at the apex is 42°–91°. In *C. namaensis* the suture is rectilinear and the apical angle between locules is 80°–150°, whereas in *C. dinteri* the suture is rectilinear but curved towards the sterile locule at the apex and the apical angle is 51°–120°. Through examination of herbarium specimens and plants in the field, a comprehensive comparative table of diagnostic characters to differentiate between the three taxa was compiled (Table 1).

**Etymology:** the specific epithet refers to the Kaokoveld of northwestern Namibia. The distribution of *C.*

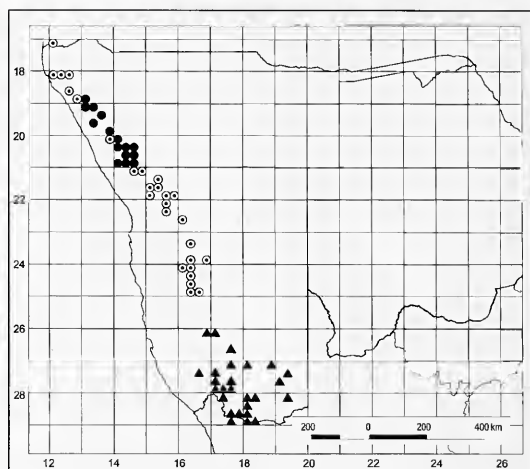


FIGURE 6.—Known distribution of *C. kaokoensis*, ●; *C. dinteri*, ○; and *C. namaensis*, ▲.

*kaokoensis* partly falls in the previous politically demarcated Kaokoland and Damaraland, now called the Kunene Region. Both these regions are included in the broader biogeographical concept of 'Kaokoveld' as a centre of plant endemism (Van Wyk & Smith 2001).

**Distribution:** *C. kaokoensis* is known from several isolated localities, all within the Kaokoveld Centre of Endemism in northwestern Namibia (Figure 6). More specific localities include the upper reaches of the Obias River (1813CC; 1913AA); just south of the Giribesvlakte (1913AB); the Kharakhaobvlakte south of Sesfontein (1913BC; –CB); Grootberg area (1913DD; 2014AA); Huab River Valley (2014AC; –AD); Petrified Forest area (2014BC); catchment area of the Goantagab River in the Doros Crater area (2014CB; –CD); Goedgenoeg area (2014DA; –DC) and along the lower Ugab River (2014CC). *C. kaokoensis* is locally common to rare within these areas, growing in loose colonies of a few plants each amongst other species of *Commiphora*, such as *C. oblancoolata*, *C. saxicola*, *C. virgata* and *C. wildii*. Unlike most of the many other species of *Commiphora* occurring in the Kaokoveld, *C. kaokoensis* is often absent from areas with seemingly suitable habitat.

**Habitat and ecology:** habitat requirements of *C. kaokoensis* are quite specific. It occurs in the Namib Desert and pro-Namib, 45–130 km from the coast at altitudes of 200–1100 m, where the annual rainfall is 75–150 mm. It grows in rocky areas preferring terraces of calcrete and outcrops consisting of metasedimentary and metamorphic rocks of the Damara Supergroup, including marble, marble-conglomerate, quartzite, gneiss and inclined strata of schist (Mendelsohn *et al.* 2002). It is restricted to calcrete formations, wherever it occurs within the extensive areas of Etendeka Group basalt, e.g. at Palm near Palmwag. In spite of extensive searching, nowhere could it be found on formations from the Karoo Supergroup and associated lavas of the Etendeka Group, not even in areas where these occur within only a few metres of *C. kaokoensis* specimens growing on rocks of the Damara Supergroup.



TABLE 1.—Salient morphological differences between *Commiphora kaokoensis*, *C. namaensis*, *C. dinteri* and *C. dinteri* (form: Uis area)

Character	States	<i>C. kaokoensis</i>	<i>C. namaensis</i>	<i>C. dinteri</i>	<i>C. dinteri</i> (Uis area)
Bark					
Older branches & stems	Fissured longitudinally (narrow & deeply); usually not parallel	Never	Always	Often	Often
	Ridged longitudinally, usually ± parallel	Always	Never	Often	Often
Leaves	Simple only	Always	Usually	Never	Rarely
	Trifoliolate only	Never	Never	Rarely	Never
	Simple with few trifoliolate	Never	Rarely	Never	Usually
	Trifoliolate with few simple	Never	Never	Usually	Never
	Simple and trifoliolate in ± equal numbers	Never	Never	Rarely	Never
Lamina shape					
Simple leaves	Obovate or elliptic to broadly so	Always	Never	Never	Never
	Orbicular, rotund rarely ovate or cordate	Never	Always	Never	Never
	Variable: obovate to elliptic, ovate, cordate, oboate or slightly oblong	Never	Never	Always	Always
Trifoliolate leaves	Obovate or broadly elliptic	Never	Always	Always	Always
Lamina margin	Crenate-serrate	Usually	Rarely	Usually	Usually
	Serrate-dentate	Rarely	Usually	Rarely	Rarely
	Subentire	Rarely	Never	Rarely	Never
Teeth on lamina margin					
Simple leaves	No. per side	(7–)14–20(–25)	(6–)9–11(–13)	(5–)10–18(–21)	(7–)11–16 (–21)
Terminal leaflets	No. per side	Never	7*	(3–)7–12(–16)	(5–)7–9(–11)
Lateral leaflets	No. per side	Never	7*	(4–)6–8(–10)	(5–)6–7(–8)
Lamina					
Simple leaves	Size (mm)	6–58 × 4–32	5–15 × 4–14	3–27 × 3–25	3–27 × 3–20
Terminal leaflets	Size (mm)	Never	5–7 × 4–5*	6–22 × 4–15	6–15 × 4–12
Lateral leaflets	Size (mm)	Never	3–5 × 2–4*	3–12 × 2–9	3–9 × 2–7
Petiole	Petiolate	Often	Always	Always	Always
	Subsessile	Often	Never	Never	Never
Petiole in <i>ts</i>					
Shape	Elliptic	Rarely	Never	Never	Never
	Crescent-shaped	Usually	Always	Never	Never
	Triangular	Never	Never	Rarely	Rarely
	Pentagonal	Never	Never	Usually	Usually
	Reniform	Never	Never	Rarely	Never
Vascular bundles	No.	5–12	3–7	3–7	3–7
Dimensions	mm	0.8–1.9 × 0.7–1.4	0.5–0.7 × 0.5–0.7	0.7–0.8 × 0.6–0.7	0.7–0.8 × 0.6–0.7
Petiole					
Simple leaves	Length (mm)	1–21	1–9	2–26	2–15
Trifoliolate leaves	Length (mm)	Never	4*	2–26	2–15
Inflorescence	Flowers solitary	Often	Never	Often	Often
	Clusters	Often	Always	Often	Often
Calyx glands	Absent	Rarely	Rarely	Never	Never
	Sparsely glandular	Usually	Rarely	Never	Never
	Profusely glandular	Never	Usually	Always	Always
Disc lobes					
Male flowers	Distal part not adnate to hypanthium	Always	Never	Always	Always
Male flowers	Distinctly bifid at apex	Always	Never	Always	Always
Male flowers	Obscurely bifid at apex	Never	Always	Never	Never
Fruit					
Shape	Ovoid	Often	Never	Often	Often
	Ellipsoid	Often	Rarely	Often	Often
	Obovoid	Rarely	Never	Rarely	Rarely
	Subglobose	Never	Usually	Rarely	Rarely
	Globose	Never	Rarely	Never	Never
	Fertile locule bent over towards sterile locule	Often	Never	Never	Never
Apex	Apiculate	Always	Never	Usually	Usually
Exocarp	Distinctly glutinous	Always	Never	Usually	Usually
	Slightly glutinous to non-glutinous	Never	Always	Rarely	Rarely
Dimensions	mm	9–13 × 7–8 × 5–7	5–10 × 5–8 × 5–7	8–11 × 7–9 × 6–8	8–11 × 7–9 × 6–8
Putamen					
Apex	Angle between locules (degrees)	(42–)53–73(–91)	(80–)90–115(–150)	(51–)80–105(–120)	(61–)80–100(–118)
Suture	Convex towards fertile locule	Always	Never	Never	Never
	A straight line	Never	Always	Never	Never
	A straight line but curved towards sterile locule at apex of putamen	Never	Never	Always	Always
Dimensions	mm	5.0–8.7 × 4.0–5.8 × 3.0–4.2	3.5–7.2 × 3.4–5.6 × 2.8–4.9	4.8–7.1 × 4.2–5.6 × 3.1–4.2	4.9–7.1 × 4.3–6.2 × 3.2–4.5

\* *Giess & Müller 14284* (WIND).

## 2. *C. dinteri* Engl.

Hitherto *C. dinteri* was regarded as having trifoliolate leaves only, with no mention of simple leaves (Van der Walt 1986). However, thorough investigation revealed that many herbarium specimens of *C. dinteri* in PRE and WIND have in addition to trifoliolate leaves, a small percentage of simple leaves, variable in shape, including ovate, obovate, elliptic, cordate, oblate, slightly oblong, or orbicular. During field work throughout the range of *C. dinteri*, both simple and trifoliolate leaves were found to a varying extent on virtually all individual plants examined. The presence of the occasional simple leaf on plants was probably overlooked (or at least not sampled) when several specimens were collected. For example, Van der Walt 201, 207 in WIND and PRE respectively, have trifoliolate leaves only, whereas the duplicates in PRE and WIND respectively, each have a few additional simple leaves. Moving north, between the Khan and Omaruru Rivers in central-western Namibia, a gradual increase in the percentage of simple leaves on specimens of *C. dinteri* was observed. Specimens from the south of this area (Stingbank and Ebony areas, 2215AB), have a small percentage of simple leaves, similar to those observed further afield in south-central Namibia at Maltahöhe (2416DD) and in the Tsaris Mountains (2416CD). To the east of the Schwarze Kuppen (2115CA; -CB), the percentage simple versus trifoliolate leaves is  $\pm$  equal, whereas in the vicinity of the Omaruru River (Nai-nais & Okombahe areas, 2115AC; -AD), the majority of leaves are simple with only a few trifoliolate leaves, both on dwarf lateral branches and on long shoots. This is likewise the case with plants from the Uis area (2114BD), which were previously considered as an isolated population of *C. namaensis* (Van der Walt 1986), probably on account of the simple leaves, which resemble those of *C. namaensis* to a certain extent. In addition to both the simple and trifoliolate leaves resembling those of *C. dinteri*, the floral structure and fruit of the plants in the Uis area resemble those of *C. dinteri* as well (Table 1). Therefore, it is concluded that all these specimens belong to *C. dinteri* and that all specimens from the Uis area (predominantly simple-leaved) were previously misidentified as being *C. namaensis*.

In the Purros area of the Kaokoveld (1812DA), predominantly simple-leaved plants (Swanepoel 26 & 27) were found alongside plants with predominantly trifoliolate leaves (Swanepoel 28, 29 & 30). The leaves were relatively large, especially on the predominantly simple-leaved plants and the petioles were long and slender, similar to those in some *C. dinteri* specimens from the Okombahe area (2115AD) in central-western Namibia. In the *Flora of southern Africa* (Van der Walt 1986), *C. dinteri* specimens with large leaves are also mentioned for plants from the Orupembe area, 60 km to the north. A specimen with predominantly trifoliolate leaves, Jacobsen & Moss K154, displays the same characteristics typical of *C. dinteri* from the Orupembe area. A specimen with simple leaves, Moss & Jacobsen K195 and from the same locality as Jacobsen & Moss K154, was previously identified as *C. cf. namaensis*, probably on account of the simple leaves, which resemble those of *C. namaensis* superficially. This specimen displays the same characteristics as Swanepoel 26, 27 with leaves large and petioles relatively slender. It lacks, however,

the presence of a few typical *C. dinteri* trifoliolate leaves as found on Swanepoel 26, 27 (only discovered on these plants upon thorough examination). The presence of the occasional trifoliolate leaf on plants was probably overlooked (or at least not sampled) when Moss & Jacobsen K195 was collected. Therefore, it is concluded that both Swanepoel 26, 27 and Moss & Jacobsen K195 belong to *C. dinteri*, and are similar to specimens from the Uis area. In all the examples mentioned above, simple and trifoliolate leaves occur on both short lateral branchlets and on long shoots. Lateral leaflets are smaller than terminal leaflets to a variable extent. Hence *C. dinteri* is considered a heterophyllous species as it usually develops both simple and trifoliolate leaves on the same plant.

## 3. *C. namaensis* Schinz

According to Van der Walt (1986), *C. namaensis* occurs as an isolated outlier population in the Uis area of north-western Namibia, in addition to being widespread in southern Namibia and the adjacent parts of South Africa. As explained above, all the plants from the Uis area should be reclassified as *C. dinteri*. Trifoliolate leaves and transitional forms of simple to trifoliolate leaves on plants under cultivation are mentioned by Van der Walt (1986) and were found on many *C. dinteri* plants during the present study, whereas only simple leaves were found on *C. namaensis* during extensive field work in southern Namibia. Trifoliolate and intermediate leaves, however, are present on a single herbarium specimen of *C. namaensis* (Giess & Müller 14284) from southern Namibia (2717AC). It is concluded that *C. namaensis* is confined to southern Namibia and adjacent areas in South Africa and that it only very rarely develops a few trifoliolate leaves in addition to the usually simple leaves.

## SPECIMENS EXAMINED

The location given for the previously unidentified specimen of *C. kaokoensis*, Giess 9427 (WIND), namely Spaarwater 711, is from a locality underlain by Etendeka lava (basalt) associated with the Karoo Supergroup. This is in stark contrast with the geological formations at all the other known localities for this species which are situated on formations of the Damara Supergroup. As expected, extensive searching for *C. kaokoensis* on the Farm Spaarwater 711 produced no specimens, nor could any suitable habitat be found. However, on the Farm Palm 708, 20 km to the northwest of Spaarwater, a few small specimens of *C. kaokoensis* were found growing on an isolated formation of calcrete within the otherwise homogeneous Etendeka basalt area. Twelve kilometres to the south of Spaarwater, on the Farm Fontaine 717, also in the basalt area, *C. kaokoensis* was found growing on an isolated outcrop of dolomite. Further explorations on Spaarwater for any calcrete formation outcrops would in all probability produce some *C. kaokoensis* specimens at that locality.

The combination of distance, bearing and quarter-degree square given for Moss & Jacobsen K195 and Jacobson & Moss K154, both *C. dinteri*, is incorrect. Investigation revealed that a point 25 km to the northwest of Purros is situated within quarter-degree square 1812DB

and not within 1812DD as given for the locality of these specimens. In addition, none of the plants in question could be found during field work in 1812DD, nor could any be found in a wide area around a point situated 25 km to the northwest of Purros. At a point, west-northwest, 25 km from Purros on the Purros-Orupembe District road (D3707), situated within 1812DA, many plants were found in habitat similar to that given for the two specimens. Therefore it seems appropriate to consider the locality for both *Moss & Jacobsen K195* and *Jacobsen & Moss K154* to be as follows: 25 km from Purros on road D3707, in quarter-degree square 1812DA.

*Acocks 15665, 18168* (3) PRE.

*Basson 204* (2a) PRE. *Biggs 209* (2a) PRE. *Botha 683* (3) PRE. *Bührman BUH 1/32, BUH 1-104* (2a) WIND. *Burgoyne 3527* (2a) PRE. *Burke 9759* (3) WIND.

*Craven 2254* (2f) WIND. *Curtis 1/9* (2a) WIND; *CUR 1/172* (2b) WIND.

*De Winter 3563* (3) PRE, WIND; *6035* (2b) PRE. *De Winter & Leistner 5737* (2a) PRE, WIND. *Dinter 958, 5148* (3) PRE. *Dreyer 480* (2a) PRE.

*Friedrich FR 12/112* (2a) WIND.

*Gerstner 6343* (3) PRE. *Giess 9427* (1) WIND; *13490A* (2a) PRE; *14520* (3) PRE; *14525, 14561* (3) WIND. *Giess & Leipert 7466* (2a) WIND. *Giess & Müller 11717* (2a) WIND; *11709* (2b) PRE, WIND; *11739* (2f) PRE, WIND; *12267* (3) PRE, WIND; *14284* (3) WIND; *14323* (3) PRE, WIND. *Giess, Volk & Bleisner 5325, 6908, 6931* (3) WIND.

*Jacobsen & Moss K154* (2b) WIND. *Jankowitz 90/813* (3) WIND.

*Mannheimer CM2317* (3) WIND. *Mannheimer & Mannheimer CM1380* (2b) WIND. *Merxmüller & Giess 935* (2b) PRE, WIND; *1688* (2f) PRE, WIND; *2703* (3) PRE. *Moss & Jacobsen K154* (2a) PRE; *K195* (2c) PRE. *Müller 1339* (2b) PRE, WIND. *Müller & Giess 361* (2g) PRE, WIND.

*Oliver & Müller 6401* (3) PRE. *Örtendahl 204* (3) PRE.

*Robinson & Knouwds 63* (2a) WIND.

*Strey 2296, 2612* (2a) PRE. *Strobach 3445* (3) WIND. *Strobach & Dauth 3752* (3) WIND. *Strobach & Kubirske 3031* (3) WIND. *Swanepoel 1* (1) PRE, WIND; *13-25, 31, 32, 40, 42-52, 72-74, 126* (1) WIND; *30, 33, 34* (2b) WIND; *28, 29, 35, 38, 41* (2c) WIND; *26, 27, 36, 37, 39* (2d) WIND.

*Van der Walt 201* (2a) WIND; *207* (2a) PRE, WIND; *267* (2a) PRE; *201* (2b) PRE; *267* (2b) WIND; *263, 305* (3) PRE, WIND; *307* (3) WIND. *Volk 11493* (2a) WIND.

*Walter 1514, 11821* (2a) WIND; *1719* (2b) WIND; *2173* (3) WIND. *Walter & Walter 2258* (3) WIND. *Ward 10805, 10889* (2b) PRE,

WIND. *Wendt 48* (3) WIND. *Wiss 1852* (3) WIND. *Werger 1507* (3) PRE.

2a, trifoliolate leaves only.

2b, predominantly trifoliolate with few simple leaves.

2c,  $\pm$  equal number of trifoliolate & simple leaves.

2d, predominantly simple with few trifoliolate leaves, excluding specimens from the Uis area.

2e, simple leaves only.

2f, specimens from the Uis area with predominantly simple & few trifoliolate leaves.

2g, specimens from Uis area with simple leaves only.

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## Two new species of Asteraceae from Northern and Western Cape, South Africa and a new synonym

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**Keywords:** Asteraceae, Cape Floral Region, *Chrysosoma hantamensis* J.C.Manning & Goldblatt, new species, *Oncosiphon*, *Senecio speciosissimus* J.C. Manning & Goldblatt, South Africa, sp. nov., systematics

### ABSTRACT

We recognize two new species of Asteraceae from the winter rainfall belt of South Africa and reduce a third to synonymy. *Senecio speciosissimus* sp. nov. has been confused with *S. coleophyllus* Turcz. in the past but is distinguished by its taller stature, larger and more finely serrated leaves, and congested synflorescences containing (6–)15–40 flowerheads. The two species are also geographically separated: *S. speciosissimus* occurs in the Hottentots Holland and Franschhoek Mountains of the southwestern Cape, whereas *S. coleophyllus* is endemic to the Riviersonderend Mountains. *Chrysosoma hantamensis* sp. nov. is a distinctive new species endemic to the Bokkeveld and Roggeveld Plateaus. It is distinguished by its resprouting habit, 3–5-fid leaves and large capitula, 12–15 mm in diameter, with lanceolate, 3-veined involucre bracts, the largest 9–10 × 2 mm. Investigation of the variation in leaf morphology of the two radiate species of *Oncosiphon*, *O. africanum* (P.J.Bergius) Källersjö and *O. glabratum* (Thunb.) Källersjö, reveals that only one species can be maintained, and *O. glabratum* is accordingly reduced to synonymy in *O. africanum*.

### INTRODUCTION

During the preparation of the account of Asteraceae for *Cape plants* (Goldblatt & Manning 2000) it was evident that several undescribed species were represented among the collections at the Compton Herbarium. The more distinctive of these taxa were included in the treatment of the relevant genera as numbered entries. Some of these species have since been described (Manning & Goldblatt 2002; Nordenstam 2003). One of the more distinctive of the unnamed species was *Senecio* sp. 3, which we describe here as *S. speciosissimus*. In addition, an unusual species of *Chrysosoma* with pinnatisect leaves from the Bokkeveld and Roggeveld Escarpment in Northern Cape is described as the new species *C. hantamensis*. At the same time we take the opportunity of reducing to synonymy the poorly understood species *Oncosiphon glabratum*, which further study reveals to be conspecific with *O. africanum*.

#### 1. *Senecio* L.

*Senecio* L., with some 1 250 species worldwide, is by far the largest genus in the tribe Senecioneae (Bremer 1994). As the central genus of subtribe Senecioninae, it is certainly paraphyletic as currently defined (Jeffrey 1986, 1992) and its circumscription is consequently rather broad. The genus is best represented in South America (± 500 species) and Africa (± 350 species) (Bremer 1994). It is especially common in southern Africa, where some 300 species have been recorded (Herman *et al.* 2000). Around one third of the southern African species have been recorded from the Cape Floral Region, where 107 named species plus four unnamed

species were recognized by Goldblatt & Manning (2000). Among the unnamed species that they listed, was an unusually striking and distinctive taxon that is described and named here.

***Senecio speciosissimus* J.C.Manning & Goldblatt, sp. nov.**

Herba perennis robusta *Senecio coleophyllo* Turcz. affinis sed 0.9–1.8 m alta, foliis grandioribus serratis (30–)40–90(–100) × 15–25(–35) mm, capitulis synflorescentia congestis (6–)15–40.

TYPE.—Western Cape, 3418 (Simonstown): Kogelberg Forest Reserve, NE slopes of Voorberg, ± 550 m, (–BD), 2 October 1971, *C. Boucher 1650* (NBG, holo.; PRE, iso.).

Robust, single-stemmed perennial, 0.9–1.8 m tall, branching above; stems and branches densely leafy in upper parts but leafless below, thinly to moderately densely cobwebbed at first, later glabrescent. *Leaves* closely imbricate, alternate, erect or lower leaves spreading to reflexed, ovate or elliptical to lanceolate, decreasing in size acropetally, (30–)40–90(–100) × 15–25(–35) mm, sessile and obscurely decurrent on stem, obtuse at base, apiculate, hard and leathery, glabrous or thinly cobwebbed at first adaxially, later glabrous or nearly so except along midrib, usually more densely and persistently cobwebbed or felted abaxially, margins revolute and sparsely 4–10-serrulate, rarely entire, 3–5-veined from base. *Capitula* heterogamous, radiate, few to several in congested corymbs aggregated into rounded or corymbose panicles of (6–)15–40 heads, terminal corymbophore ± 40 mm long, individual peduncles 10–30(–50) mm long, cobwebbed, with 1–5 scattered, lanceolate bracts. *Involucre* campanulate, calyculate, 7–12 mm diam.; involucre bracts uniseriate, 13–18, 9–13 × 1.8–3.0

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FIGURE 1.—*Senecio speciosissimus*, Boucher 1650, holo. (NBG).

mm, ± equalling disc, lanceolate, acute or attenuate, mostly with scarios margins, ciliate-penicillate at tips, veins resinous, especially in lower half. *Receptacle* flat, glabrous. *Ray florets* female, 11–13; tube compressed-cylindrical, ± 4 mm long, abaxial (outer) side sparsely glandular-pubescent in upper half; lamina spreading, elliptic-oblong, 4(–6)-veined, 18–20 × 5–8 mm, pink or mauve, rarely white. *Style* branching just below mouth of tube, branches narrowly oblong, 1.5 mm long, lateral margins stigmatic, apices obtuse, shortly papillate. *Disc-florets* bisexual, many, ± 6 mm long, glabrous, yellow; lower part of tube cylindrical, ± 4.5 mm long, limb narrowly campanulate, ± 2 mm long, 5-lobed; lobes triangular, 1.8 × 0.8 mm, with submarginal veins and median resin duct. *Anthers* 2.5 mm long including ovate apical appendage; anther base minutely sagittate, ecaudate. *Ovary* narrowly ellipsoid, 8–10-ribbed, clavate-pubescent between ribs; style terete with swollen base on distinct stylodopodium, branching just below mouth of tube, branches ± 1 mm long, lateral margins stigmatic, apices truncate with crown of papillae. *Cypselas* narrowly ellipsoid, ± 6.0 × 1.8 mm, 8–10-ribbed, clavate-pubescent between ribs, reddish brown. *Pappus* present in all florets, bristles numerous, uniseriate, white, barbellate, deciduous, 4–5 mm long. *Flowering* time: June to November. Figure 1.

*Distribution and ecology:* Western Cape, restricted to the southwestern coastal mountains between 600 and 1 500 m, from Bainskloof in the north to Kogelberg in the south, a distance of ± 40 km (Figure 2). Plants grow

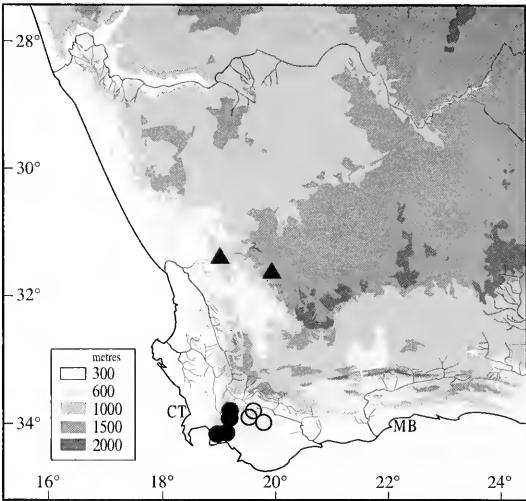


FIGURE 2.—Distribution of *Senecio speciosissimus*, ●; *S. coleophyllus*, ○; and *Chrysocoma hantamensis*, ▲

in scattered communities, never very abundantly, in moist fynbos vegetation, in seepage areas or along streams. Rainfall in these mountains is relatively high, in parts averaging more than 2 500 mm per annum, falling predominantly during the winter months, although summer cloud condensing against the upper slopes provides some moisture through the summer. The single-stemmed, willowy growth form indicates that the species is a reseed, re-establishing after fire through the germination of dispersed seeds. Plants seem to be relatively short-lived and the species is apparently a member of early successional plant communities that do not persist into more mature fynbos older than 10 years. Flowering of the species begins in winter, in July, and continues into late spring and early summer, in November or December, with peak flowering between August and October.

*Diagnosis and relationships:* *Senecio speciosissimus* is a distinctive species. Plants are single-stemmed, with erect, wand-like stems up to 1.8 m tall that are branched near the tops and densely leafy towards the tips. The ovate to lanceolate, leathery leaves are usually cobwebbed beneath, and the flowerheads are clustered in panicle synflorescences, with pink to mauve (rarely white) ray florets. In its habit, foliage and pink ray florets, it approaches *Senecio coleophyllus* Turcz. (Figure 3), a smaller species, 0.5–1.0 m tall, of similar moist montane habitats in the Rivier-sonderend Mountains to the east, and the two are apparently geographic vicariants. *S. speciosissimus* is readily distinguished from *S. coleophyllus* by its taller stature, 0.9–1.8 m tall, and congested, panicle synflorescences comprising several, relatively short inflorescences in the upper leaf axils of the flowering branches, producing an accumulated total of (6–)15–40 flowerheads. *S. coleophyllus*, in contrast, produces a solitary, slender peduncle ± 100 mm long at each branch tip, bearing 1–3(–5) flowerheads. The leaves in that species are also smaller, 20–30 mm long vs 30–90 mm long, and proportionately more deeply and coarsely incised. *S. glastifolius* L.f., from moist mountain





FIGURE 3.—*Senecio coleophyllus*, Oliver 10919 (NBG).

slopes between George and Humansdorp, is another tall, purple-flowered species that bears a superficial resemblance to *S. coleophyllus* and *S. speciosissimus*. It is readily distinguished from both by its thinner-textured leaves with the margins flat or only slightly revolute, the complete lack of indumentum on leaves and inflorescence, its diffuse synflorescence, and by the narrower, linear involucre bracts, at most 1.5 mm wide.

**History:** this striking species appears to have been first collected by the German botanist Rudolf Schlechter in the mountains above Franschhoek in November 1896. Several collections have been made since then, all of which have been referred to *S. coleophyllus*, and the plant has been illustrated under that name in various wild flower guides (Anonymous 1980; Burman & Bean 1985). This persistent confusion has obscured the true identity of the species. During the preparation of *Cape plants* (Goldblatt & Manning 2000), when we had the opportunity to examine recent collections of *S. coleophyllus* from the Riviersonderend Mountains, it was clear to us that the plants from the Hottentots Holland Mountains represented a distinct species, and it was accordingly included in the account as *Senecio* sp. 3. The type of *Senecio coleophyllus* is from the Riviersonderend Mountains, as are all subsequent collections that match it. The recognition of the populations from the Hottentots Holland and adjacent mountains as a distinct species, *S. speciosissimus*, confirms that *S. coleophyllus* is endemic to the Riviersonderend Mountains, where it is found along the length of the range, from Jonaskop in the west to Pilaarkop in the east (Figure 2).

Other material examined

*Senecio speciosissimus*

WESTERN CAPE.—3319 (Worcester): lower NE slopes of Seven Sisters Mountain, above Witte River Valley, (–CA), 29 November 1959, *E. Esterhuysen* 31995 (BOL, S); Tierkloof on lower slopes of Wemmershoek Mountains, (–CC), 5 November 1950, *E. Esterhuysen* 17699 (BOL); Franschhoek Pass, (–CC), 2 December 1928, *H. Herre* s.n. STE8989 (NBG); Franschhoek, (–DD), 19 November 1896, *R. Schlechter* 9266 (BOL, PRE); Franschhoek Peak, (–DD), 6 October 1946, *R.H. Compton* 18550 (BOL). 3418 (Simonstown): Sneekup, (–BB), 7 November 1938, *T.P. Stokoe* PRE44832 (PRE); Nuweberg Forest Reserve, north slope of Sneekup, (–BB), 26 November 1969, *M.F. Thompson* 993 (NBG, PRE); sheltered valley on E side of Somerset Sneekup, (–BB), December 1939, *E. Esterhuysen* 3533 (BOL); Hottentots Holland Mtns, (–BB), November 1923, *T.P. Stokoe* BOL17561 (BOL); Hottentots Holland, (–BB), 13 November 1930, *T.P. Stokoe* PRE20583 (PRE); Sir Lowry's Pass (bought in Adderley Street), (–BB), September 1917, *BOL14010* (BOL); Steenbras Dam on Farm Rockview, (–BB), 7 June 1982, *C.M. van Wyk* 988 (NBG); foot of Kogelberg Peak, (–BB), 18 August 1970, *F.J. Kruger* KR1047 (NBG, PRE); Kogelberg State Forest, southern end of Five Beacon Ridge, (–BB), 8 October 1980, *C. Boucher* 4976 (NBG); Kogelberg, kloof running down to Steenbras Dam, moist area near stream, (–BD), 27 August 1971, *E.G.H. Oliver* 3461 (NBG, PRE); Palmiet River Mountains, (–BD), August 1924, *T.P. Stokoe* 977 (PRE); mountains near Palmiet River, (–BD), April 1936 (fr.), *T.P. Stokoe* s.n. (BOL); Kogelberg, (–BD), August 1924, *Stokoe* 962A (BOL, PRE); between Kogelberg and Cape Hangklip, (–BD), October 1920, *T.P. Stokoe* 623 (PRE); Hangklip, (–BD), 16 October 1923, *T.P. Stokoe* PRE44828 (PRE); Hangklip, (–BD), September 1917, *Marloth* 7745 (PRE); Pringle East Peak, sheltered SW slopes and cliffs, (–DD), 16 September 1951, *E. Esterhuysen* 18859A (BOL); Pringle East Peak, steep S slope below summit, 2500 ft, (–DD), 21 September 1952, *E. Esterhuysen* 20409 (BOL, PRE); swamp on S slopes of mountains near Betty's Bay, (–BD), *E. Esterhuysen* 13711 (BOL). 3419 (Caledon): between Viljoen's Pass and Somerset Sneekup, (–AA), 3 October 1938, *T.P. Stokoe* 7039 (BOL); Grabouw-Boland trail, upper Riviersonderend River, 600 m, (–AA), 29 October 1983, *C. Burman* 1243 (BOL).

*Senecio coleophyllus*

WESTERN CAPE.—3319 (Worcester): Riviersonderend Mtns, Jonaskop, moist slopes among rocks, (–CD), 25 January 1982, *J.P. Rourke* 1772 (MO, NBG, PRE); Onklaarberg, 20 miles S of Worcester, (–DC), December 1924, *T.P. Stokoe* 1073 (PRE). 3419 (Caledon): Riviersonderend Mtns, Schilpadkopp, steep, marshy, S slope, (–BA), 30 November 1952, *E. Esterhuysen* 20791 (BOL); Riviersonderend Mtns, Pilaarkop, moist rocky area, (–BB), 28 October 1997, *E.G.H. Oliver* 10919 (NBG); Riviersonderend Mtns, (–BB), November 1940, *T.P. Stokoe* SAM57807 (SAM), October 1945, *T.P. Stokoe* SAM57546 (SAM); Riviersonderend, (–BB), *K.H. Barnard* 472 (SAM); mountains near Riviersonderend, Appelskraal, (–BB), November 1830, *Zeyher* 2953 (K, PRE!, S, SAM!, iso.).

2. *Chrysocoma* L.

*Chrysocoma* L., a genus of 20 species, is endemic to southern Africa, mainly the drier western and southwestern regions, with a single species extending into Mozambique (Bayer 1981; Herman *et al.* 2000). In the tribe Astereae the genus is distinguished by its shrubby habit and linear or oblanceolate leaves that are usually viscid, mostly entire and often ericoid, usually solitary capitula borne on elongate, naked peduncles, biseriate pappus with an outer series comprising a row of minute, persistent scales and an inner series of caducous bristles, and flattened cypselae with thickened margins containing apical resin sacs beneath the marginal ribs. All but two species have discoid capitula and just a single species, *C. tridentata* DC. is known to have some of the leaves toothed or lobed (Bayer 1981). The species described here as *C. hantamensis* is anomalous in

*Chrysocoma* in its distinctly pinnatifid leaves and unusually large capitula but accords with the genus in other respects, particularly the fruit characters.

***Chrysocoma hantamensis* J.C.Manning & Goldblatt, sp. nov.**

Species insignis suffrutescens, ramis decumbentibus, foliis 3(–5)-fidis, capitulis magnis 12–15 mm diam. solitariis, bracteis involucri lanceolatis 3-costatis, 9–10 × 2 mm.

TYPE.—Northern Cape, 3119 (Calvinia): 12 km E of Nieuwoudtville, 2.5 km S of Calvinia road, (–AC), 12 September 2004, *P. Goldblatt & L.J. Porter 12418* (NBG, holo.; E, K, MO, PRE, S, iso.).

Suberect subshrub with strong taproot; stem partly subterranean, compactly branched, producing annual flowering shoots; branches decumbent, woody at base and closely leafy, becoming pedunculoid and almost naked distally, 150–250 mm tall, sparsely villous with hairs 0.5–0.75 mm long. *Leaves* patent or suberect, lowermost opposite and decussate with bases connate but soon becoming alternate, rarely subtending dwarf axillary shoots, mostly trifid or subdigitately pinnatisect and then 5-lobed, outline spatulate, 10–14 × 4–6 mm, lobes linear-lanceolate, 3–6 × 0.8–1.0 mm, obtuse, lower leaves and often uppermost becoming progressively oblong-lanceolate, 1.0–1.5 mm wide, leathery, margins strigose with coarse hairs 0.75 mm long and scattered glandular hairs. *Capitula* homogamous, discoid, solitary, terminal, pedunculate; peduncle sparsely villous but densely villous apically beneath capitula, (40–)60–100 mm long, naked or with one or two linear-lanceolate bracts 6–8 mm long. *Involucre* broadly hemispherical, 7–8 × 12–15 mm; involucre bracts 4(5)-seriate, lanceolate, thinly hairy or subglabrous, with narrow, scarious, fimbriolate margins, 3-veined, outer bracts 5–6 × 1–2 mm, acute, sparsely or more closely ciliate with hairs ± 0.5 mm long, inner bracts 9–10 × 2 mm, acuminate-attenuate, glabrous. *Receptacle* convex, epaleate, alveolate. *Florets* bisexual, yellow or apparently reddish at tips, tube cylindrical but widening slightly in upper 2.0–2.5 mm, middle third sparsely pubescent with tapering, eglandular hairs, 4.5–5.0 mm long, 5-lobed; lobes recurved, triangular with thickened margins, ± 0.8 × 0.4 mm. *Anthers* ± 2 mm long including ovate, somewhat keeled apical appendage; anther bases obtuse, ecaudate. *Ovary* obovate, flattened with thickened margins, adpressed-hairy; style terete, branches ± 1 mm long, incurved, linear, margins stigmatic, apical appendage triangular, papillate with sweeping hairs at base. *Cypselae* obovate, ± 3.0 × 1.5 mm, flattened with thickened margins, moderately densely adpressed-hairy, with two small apical resin sacs beneath ridges. *Pappus* biseriate; outer series of minute, obtuse scales united basally in ring; inner series of ± 20 bristles, 3–4 mm long, barbellate above but subplumose basally, caducous. *Flowering time*: August and September. Figure 4.

*Distribution and ecology*: Northern Cape, known from two populations on the Bokkeveld and northern Roggeveld Escarpments (Figure 2). This region, known locally as the Hantam (Manning & Goldblatt 1997), is a significant centre of endemism (Van Wyk & Smith 2001). *C. hantamensis* appears to be restricted to doleritic clays, growing in

succulent karoo vegetation. The fine-grained, red dolerite soils of the Hantam support a wealth of edaphic endemic taxa adapted to their peculiar characteristics, including other recently described species of Asteraceae (Manning & Goldblatt 2001). *C. hantamensis* bears a remarkable superficial resemblance to another distinctive, narrow endemic of this region, *Euryops mirus* B.Nord. The two species, which grow together at the type locality east of Nieuwoudtville, are extraordinarily similar in vegetative form, sharing short, partially subterranean stems and branches bearing pinnatifid leaves, and producing annual flowering shoots with long, naked peduncles bearing solitary flowerheads. It would appear to be a marked instance of ecological convergence.

*Diagnosis and relationships*: the highly distinctive *C. hantamensis* is readily separated from all other species of *Chrysocoma* by its 3–5-fid leaves and large capitula, 12–15 mm diam. with lanceolate, 3-veined involucre bracts, the largest 9–10 × 2 mm. In its distinctly lobed leaves it approaches *C. tridentata* DC. (including *C. pinnatifida* DC.) (Bayer 1981) but this species from the Little Karoo is a divaricately branched shrublet with rather fleshy, mostly subterete leaves, and with short peduncles at most 30 mm long, bearing capitula 10–12 mm diam. In addition, the involucre bracts, like those of all other species of *Chrysocoma*, are smaller, ± 5 × 1.0–1.5 mm, linear-lanceolate and 1-veined. *C. hantamensis* is probably most closely allied to *C. oblongifolia* DC., which extends from Namaqualand through the Hantam and into the Tanqua Karoo. Both species are subshrubs with decumbent annual stems bearing relatively broad leaves with strigose margins and large capitula carried on long peduncles. The decussate lower leaves of *C. hantamensis* and *C. oblongifolia* are also evident in the few other species of *Chrysocoma* that are subshrubs rather than true shrubs, although their opposite arrangement is easily overlooked. *C. oblongifolia* differs from *C. hantamensis* in its entire, oblanceolate leaves, glandular-hairy rather than villous stems and peduncles, slightly smaller capitula, 10–12 mm diam., and smaller, 1-veined involucre bracts.

*History*: this unusual species was brought to our attention by Simon Todd, who collected it as part of his vegetation studies in the Nieuwoudtville area. Subsequent investigation brought to light an earlier collection from the northern Roggeveld Escarpment, made by M.F. Thompson in 1975, at which time it was filed among the undetermined species of *Chrysocoma*. The specimen was apparently overlooked by Bayer (1981) in her revision of the genus.

*Additional material examined*

NORTHERN CAPE.—3119 (Calvinia): 10 km towards Calvinia from Nieuwoudtville along R27, ± 2.5 km S of road, (–AC), September 2003, *S. Todd 302* (NBG); N end of Roggeveld Escarpment, De Hoop, (–DD), 22 August 1975, *M.F. Thompson 2534* (NBG, PRE).

**3. *Oncosiphon Källersjö***

The genus *Oncosiphon* Källersjö (Anthemidae: Matricariinae) (Källersjö 1988) was established for a small group of annual species from Western and Northern Cape

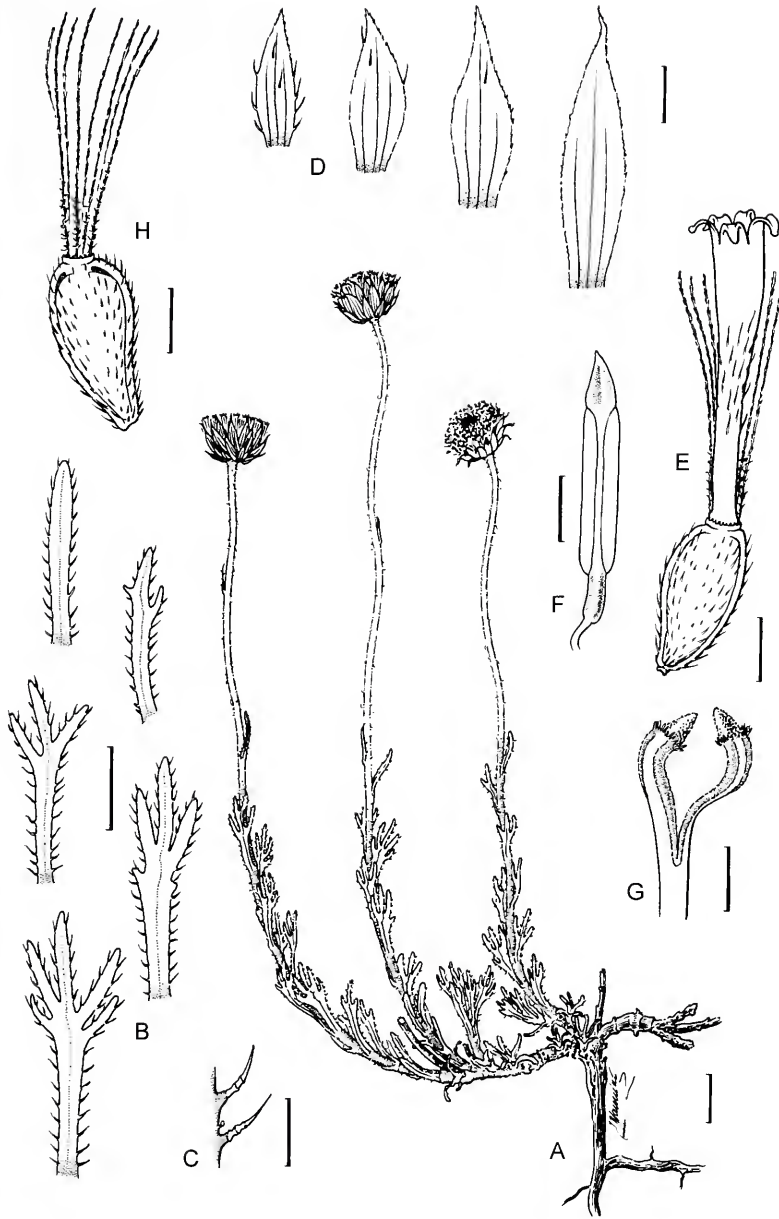


FIGURE 4.—*Chrysocoma hantamensis*, Todd 302 (NBG). A, whole plant; B, variation in leaf morphology; C, detail of leaf margin; D, involucre bracts (outermost on left, innermost on right); E, floret; F, single anther; G, style branches; H, cypselae. Scale bars: A, 10 mm; B, 5 mm; D, 2 mm; E, H, 1 mm; C, F, G, 0.5 mm. Artist: J. Manning.

that had been previously placed either in *Matricaria* (Harvey 1865), or segregated between the genera *Pentzia* (discoïd species) and *Matricaria* (radiate species) (Hutchinson 1917). As circumscribed by Källersjö (1988), *Oncosiphon* is defined by its annual habit, 4-lobed corolla with a brittle, swollen tube, and 4-ribbed cypselae that lack myxogenic hairs and bear a small, unequal-sided pappus. Seven species are currently recognized in the genus (Källersjö 1988), just two of them with radiate capitula. These two species, *O. africanum* (P.J.Bergius) Källersjö and *O. glabratum* (Thunb.) Källersjö, are endemic to the coastal lowlands of the southwestern Cape (Goldblatt & Manning 2000), from near Leipoldtville to Cape Town. They occur along the margins of seasonal, often somewhat saline pans, and flower in late spring as the pans dry out. The two species

were retained as distinct by Källersjö (1988) on the basis of the degree of dissection of the lower leaves. The leaves in *O. glabratum* are described as simply pinnatisect, whereas in *O. africanum* the lower leaves at least are bipinnatisect. The degree of leaf dissection is notoriously variable within species of Asteraceae (see Hilliard 1977). Significantly, no well-preserved recent specimens have been unequivocally associated with *O. glabratum* among the collections of radiate *Oncosiphon* material that we have examined. The collection *Ecklon & Zeyher 213/323* (SAM) that was associated with this species by Harvey (1865), actually has distinctly bipinnatisect leaves and thus falls within the circumscription of *O. africanum*. In contrast, the ample material determined as *O. africanum* displays a range of leaf forms that suggests that the degree of dissection is often associated with the luxuriance of the



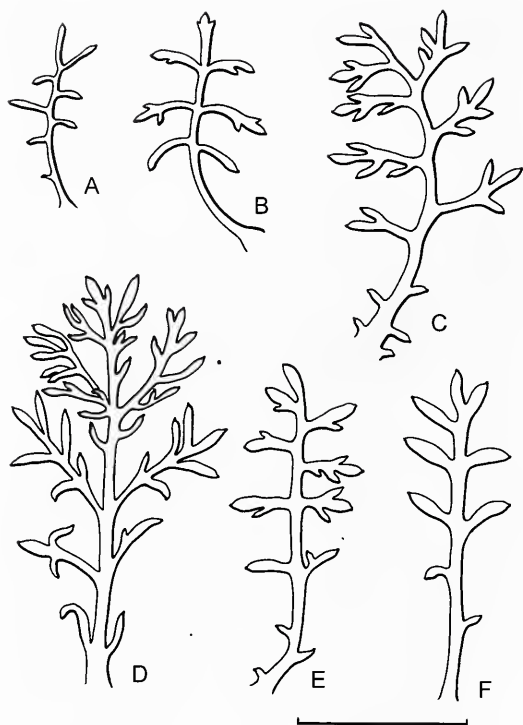


FIGURE 5.—*Oncosiphon africanum*, variation in lower leaves. A, B, leaves from two different plants, *Compton 9815* (NBG); C, leaf from *Compton 5086* (NBG); D–F, leaves from three different stems on single plant, *Compton 15129* (NBG). Scale bar: 10 mm. Artist: J. Manning.

plants (Figure 5). Well-grown, branched specimens typically have larger, more highly dissected leaves than smaller, unbranched specimens. For instance, *Compton 9815* (NBG) comprises a dozen depauperate plants, most of which bear simple, pinnatisect leaves (Figure 5A) but one of which has the lower leaves weakly bipinnatisect (Figure 5B). While most of the leaves of *Compton 5086* (NBG) are bipinnatisect (Figure 5C), the lower leaves of different branches on the well-grown plants that comprise *Compton 15129* (NBG) and *Hugo 667* (NBG) display a range of degrees of dissection, from simply pinnatisect to strongly bipinnatisect (Figure 5D–F). The leaves in all other species of *Oncosiphon* are bipinnatisect (rarely tripinnatisect) (Goldblatt & Manning 2000). Examination of the type of *O. glabratum*, which comprises unbranched plants, reveals that one of the leaves displays a secondary lobe and is therefore by definition bipinnatisect. The distinction between the two taxa is clearly untenable and *O. glabratum* is accordingly reduced to a synonym of *O. africanum*.

***Oncosiphon africanum* (P.J.Bergius) Källersjö** in Botanical Journal of the Linnean Society 96: 312 (1988). *Matricaria africana* P.J.Bergius: 296 (1767). Type: Western Cape, Milnerton, 2 March 1800, *H.P. Linder 2208* (BOL, neo.), designated by Källersjö (1988).

*Oncosiphon glabratum* (Thunb.) Källersjö in Botanical Journal of the Linnean Society 96: 312 (1988). *Matricaria glabrata* (Thunb.) DC.: 51 (1838). *Chrysanthemum africanum*

Thunb.: 161 (1800). Type: South Africa, *Thunberg no. 20132* in Herb. Thunb. (UPS, microfiche!), syn. nov.

#### Other material examined

WESTERN CAPE.—3218 (Clanwilliam): outside Leipoldtville on road to Sandberg, (–BC), 13 October 1976, *L. Hugo 667* (NBG); Clanwilliam, Bergvlei, (–BC), 23 September 1934, *R.H. Compton 5086* (NBG); Piketberg, Pappkuil Valley, (–CA), 22 September 1940, *Compton 9523* (NBG); salt marsh opposite Berg River Marsh, (–CC), 14 October 1986, *M. O'Callaghan 1159* (NBG); Berg River, (–CD), 21 September 1940, *R.H. Compton 9469* (NBG); Berg River Station, (–CD), 1 October 1943, *R.H. Compton 15129* (BOL, NBG). 3318 (Cape Town): halfway between Yzerfontein and Langebaan turnoff, near Salt Pan, (–AA), 3 August 1985, *Källersjö 29* (BOL, S); north of Yzerfontein, (–AB), 21 November 1991, *A. Craven 26* (NBG); Yzerfontein, (–AB), August 1931, *L. Bolus s.n.* (BOL); Mamre Road, (–BD), 12 October 1940, *R.H. Compton 9815* (NBG); Cape Town, Rietvlei, (–CD), *C.F. Ecklon & C.L. Zeyher 213/323* (SAM); Observatory, Varschvlei, (–CD), 10 November 1891, *C. Wolley Dod 3636* (BOL); Rugby near Milnerton, (–CD), February 1939, *M.R. Levyns 7016* (BOL); Paarden Island, (–CD), December 1920, *Pole Evans BOL16870* (BOL).

#### ACKNOWLEDGEMENTS

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# Notes on African plants

VARIOUS AUTHORS

## PROTEACEAE

### A NEW *LEUCADENDRON* (PROTEACEAE) FROM WESTERN CAPE, SOUTH AFRICA

The discovery of a large new species of *Leucadendron* R.Br., strikingly different from its congeners in growth habit, brings to 85 the number of *Leucadendron* species currently known, thus making it the largest genus of Proteaceae in southern Africa. Discovered by Dr Tony Rebelo on the final annual field outing of the Protea Atlas Project in March 2001, this remarkable species is here described as *L. immoderatum* on account of its extraordinary growth habit.

***Leucadendron immoderatum* Rourke, sp. nov.**, species distinctissima propter habitum dimorphum et folia dimorpha: acicularia in ramis vegetativis, obovata apicem versus in ramis reproductivis. Inflorescentiae gemmis masculinis et femineis intra involucrium conico-acutam inclusis. Bracteae involucrales lanceolato-acutae vel lineari-acuminatae, per anthesin cadentes.

**TYPE.**—Western Cape, 3319 (Worcester): Riviersonderend Mountains, Olifantsberg, north side between Doring and Witte Rivers, on a saddle facing northwest, (–CD), 12-11-2001, *J.P. Rourke* 2224 (NBG, female specimen, holo.!, PRE, K, MO, iso.!).

Robust, erect shrub up to 2 m tall with a single main stem branching just above ground level; growth habit and leaves dimorphic. *Basal vegetative branches* highly divaricate with acicular terete leaves, forming a dense mat up to 2 m diam; up to 0.7 m tall, from which emerge 5–14 stout, woody, reproductive branches, bare when mature except for flat, obovate leaves at apex of each shoot. *Basal branches* 3–5 mm diam., covered with prominent, closely arranged leaf scars. *Basal leaves* acicular-terete, 10–20 × 1.0–1.5 mm, densely ascending to slightly incurved, upper surface canaliculate, initially sparsely sericeous, soon glabrous becoming slightly glaucous, apex mucronate. *Reproductive branches* stout, erect, straight, 8–15 mm diam., elongating up to 0.7–1.0 m, initially with broadly linear leaves, 15 × 5 mm, soon caducous, leaving branches bare. *Upper leaves* flat, oblanceolate to obovate, 25–55 × 10–20 mm, glabrous, apices rounded, minutely uncinat. *Male capitula* in groups of 3–6 on short shoots towards apex of reproductive branches. *Bud stage* enclosed in a conic-acute involucre of ovate-acute bracts, 5–25 × 5–7 mm, glabrous, margins ciliate; caducous at anthesis. *Inflorescence* broadly cylindric, 25 × 20 mm, minutely pedunculate. *Floral bracts* broadly ovate, acute 1 × 1 mm, glabrous, margins ciliate. *Perianth* glabrous, straight, 5–6 mm long, pale yellow; perianth claws equally recurved at anthesis. *Anthers* ± 3 mm long. *Style* filiform, straight, 5–6 mm long, glabrous. *Pollen presenter* clavate, ± 3 mm long. *Hypogynous scales* linear-obtuse, 1 mm long.

*Female capitula* solitary or up to 3 on short branchlets at apex of reproductive shoot surrounded by a loose pseudowhorl of erect, greenish yellow/ivory leaves. *Bud stage* enclosed in a conic-acute involucre of lanceolate-acute to linear-acuminate bracts, 5–12 × 3–40 mm, glabrous but margins densely ciliate-sericeous; caducous at anthesis. *Inflorescence* cylindric, sessile, 40–50 × 10 mm. *Floral bracts* very broadly ovate-acute, 5 × 6 mm, horizontally patent, projecting, cartilaginous, glabrous, but apex minutely crinite. *Perianth* 4–15 mm long, zygomorphic, laterally compressed; lateral perianth claws densely sericeous, adaxial and abaxial claws sparsely sericeous to glabrous. *Staminodes* 3; anterior staminode absent. *Style* straight ± 4 mm long, patent, partially clasped by sterile anterior perianth limb. *Pollen presenter* oblong-clavate, terminal, adaxial surface glandular. *Ovary* ovoid-compressed, 1 mm long, sharply differentiated from style base, glabrous. *Hypogynous scales* lanceolate-obtuse, 1 mm long, carnos. *Mature cone* 30–40 × 60–90 mm, prominently ridged. *Fruit* a rounded, flattened, black, samara, 8 × 10 mm, apically retuse. Figures 1–3.

**Diagnostic characters:** this species is unique in the genus on account of the conic-acute, 40–55 mm long involucre that completely enclose both male and female inflorescences in their bud stages giving the inflorescence buds the appearance of small species of *Protea* or certain species of *Pteronia* (Asteraceae). These involucral bracts are rapidly caducous at anthesis, linear-lanceolate and up to 45 mm long in female inflorescences, ovate-acute and up to 7 mm long in male inflorescences. (*L. microcephalum* also has large involucral bracts but these only partially enclose the inflorescences and persist into the post-pollination phase).

*Leucadendron immoderatum* is further distinguished by its dimorphic growth habit and dimorphic foliage with a few stout, erect, reproductive branches bearing broadly obovate leaves around the capitula, developing from a dense, highly dichotomous basal growth, producing acicular-terete leaves.

**Affinities:** morphological evidence, especially seed, cone and leaf characters suggest that *L. immoderatum* is best accommodated in *Leucadendron* sect. *Alatosperma* subsect. *Compressa*. This subsection contains a number of species with predominantly acicular-terete leaves that have a tendency to become flattened and broader (very narrowly oblanceolate) around the inflorescence in some species (Williams 1972). *Leucadendron comosum* (Thunb.) R.Br. subsp. *comosum* may be the most closely allied species but the leaf dimorphism is very much more pronounced in *L. immoderatum*. The extreme dimorphic

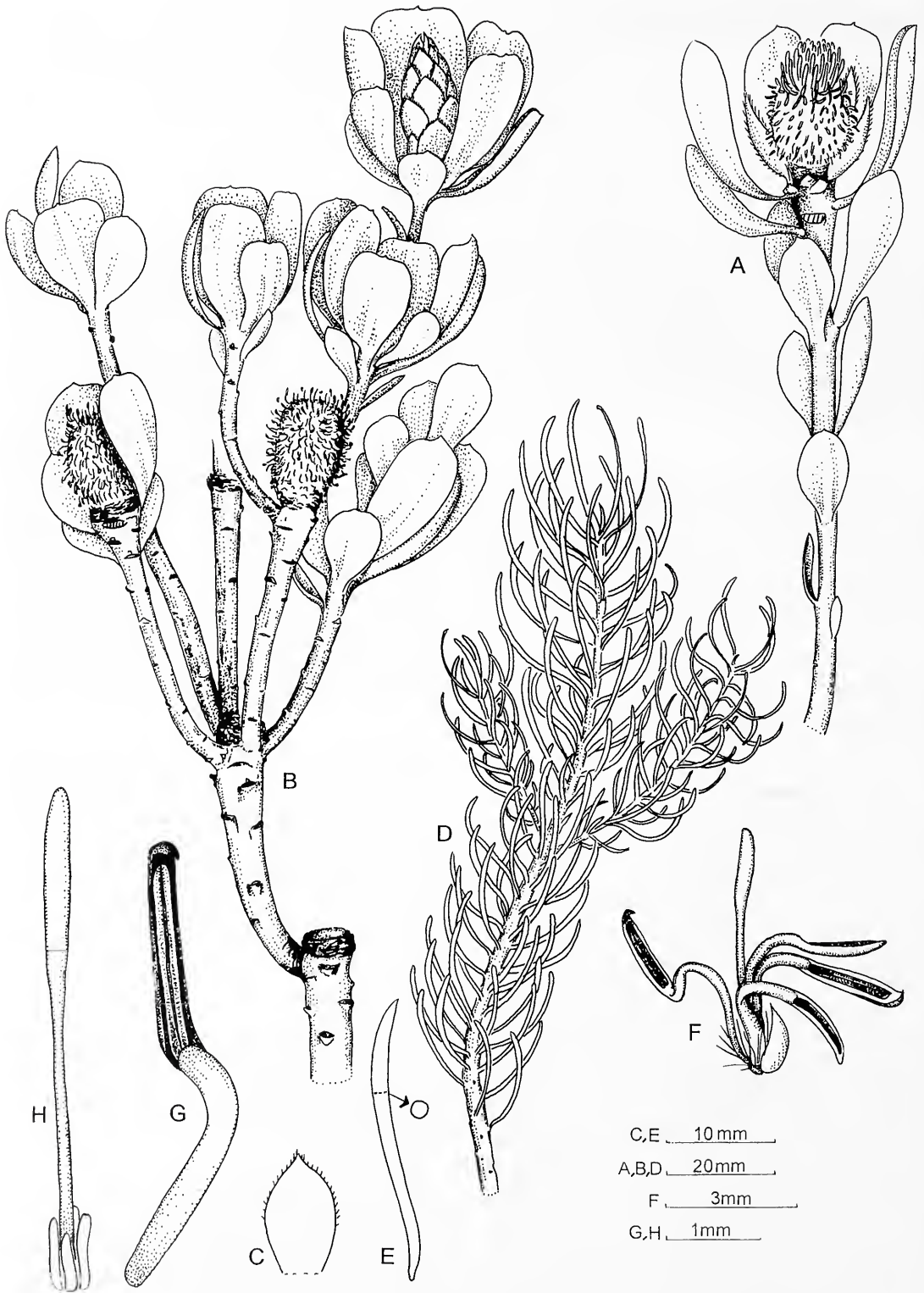


FIGURE 1.— Male inflorescences of *Leucadendron inmoderatum*, Rourke 2224. A, fully open; B, previous year's inflorescences and inflorescence bud enclosed in involucre; C, basal involucre bract; D, juvenile foliage; E, single juvenile acicular leaf; F, male flower and subtending floral bract; G, single perianth segment and anther; H, style, pollen presenter and hypogynous scales. Artist: I.M. Oliver.

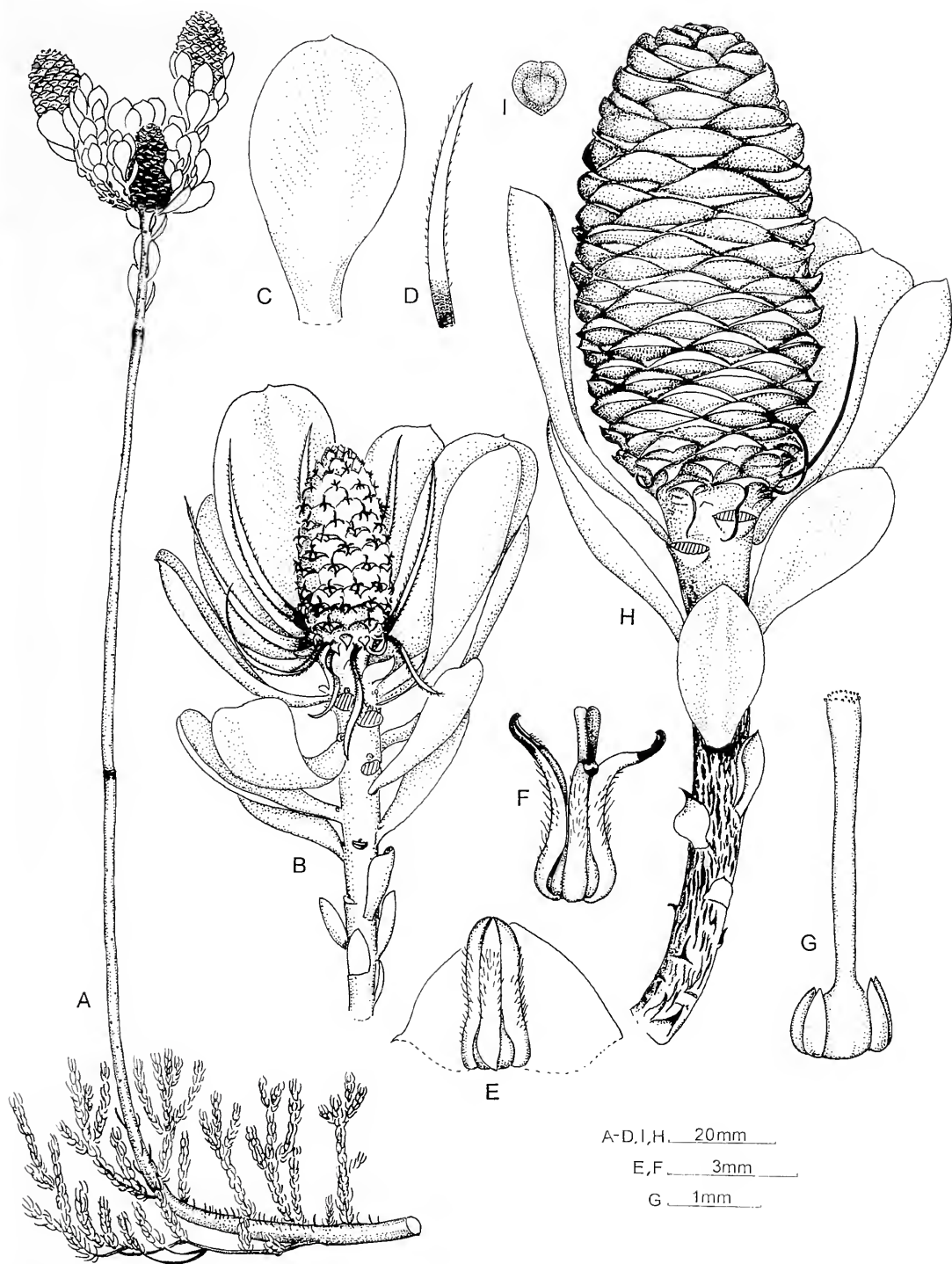


FIGURE 2.—Female inflorescences of *Leucadendron inmoderatum*, Rourke 2224. A, complete branch system showing basal juvenile foliage, reproductive branch with long growth increments and terminal obovate leaves; B, flowering female cone with remnants of involucre bracts; C, obovate upper leaf; D, involucre bract; E, unopened female flower and subtending floral bract (cone scale); F, open female flower; G, gynoecium with hypogynous scales; H, mature female cone, I, mature fruit. Artist: I.M. Oliver.



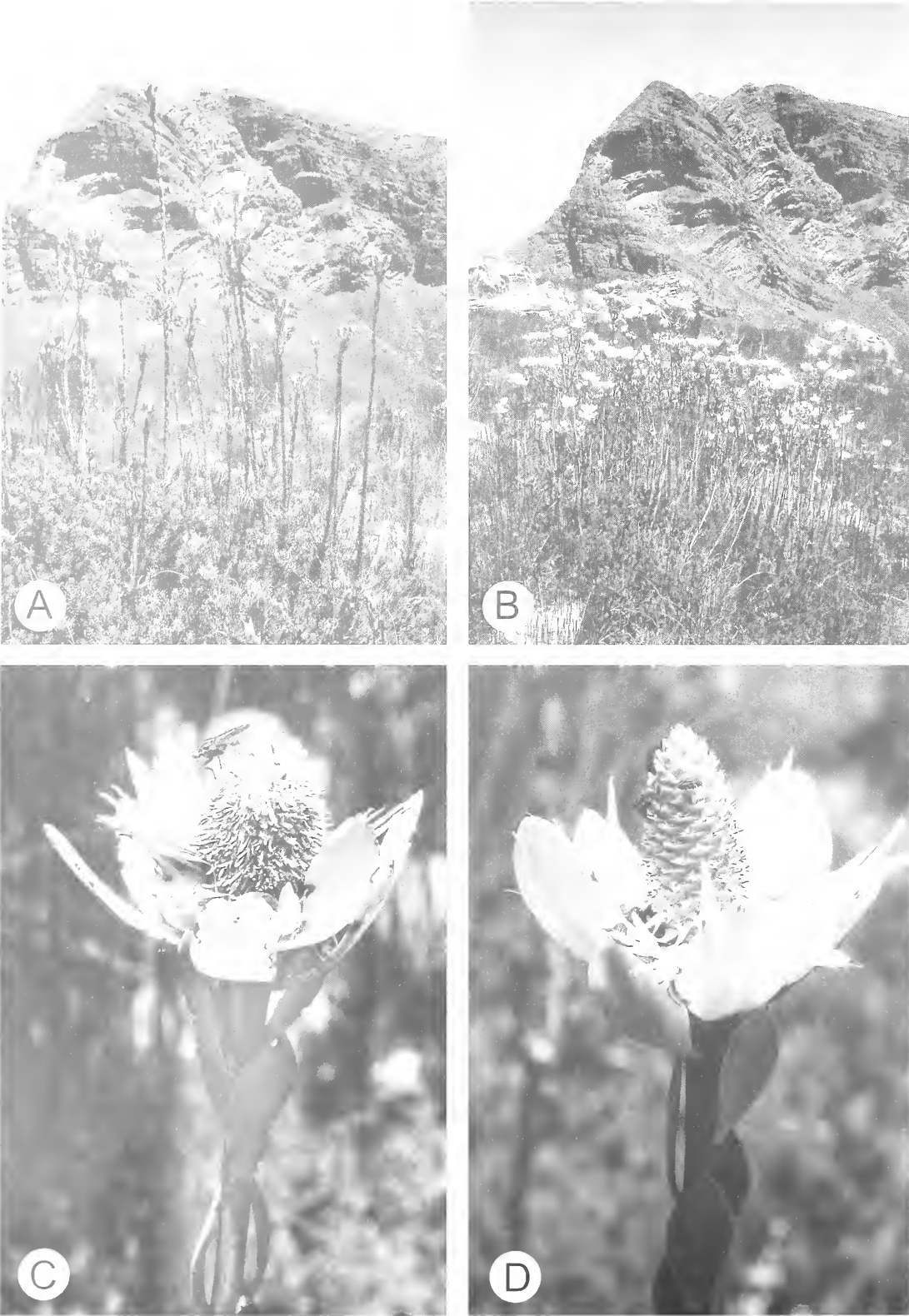


FIGURE 3. *Leucadendron immoderatum* Rourke. A, female and B, male plants in the type locality. The peak in the background, unnamed on modern maps, is immediately adjacent to and west of Olifantsberg. C, male inflorescence; D, female inflorescence. Note the remnant acuminate involucre bracts abscising at the base of each inflorescence.

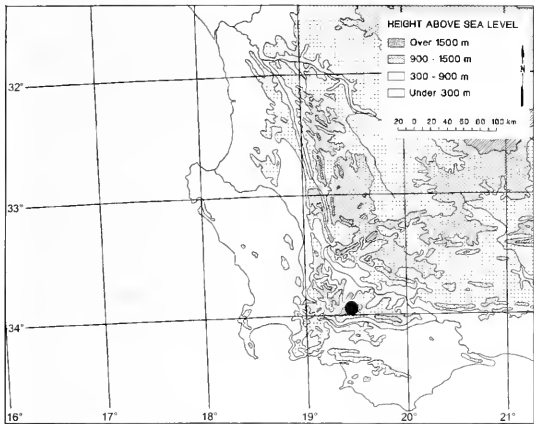


FIGURE 4.—Distribution of *Leucadendron immoderatum* Rourke.

growth habit of *L. immoderatum*, in which the adult shrub is sharply differentiated into vegetative and reproductive branch systems, represents a unique apomorphy within this lineage.

**Distribution:** *Leucadendron immoderatum* is known from a single population growing in mesic mountain fynbos at about 1 300 m on the upper north slopes of Olifantsberg in the Riviersonderend Mountains on a north-west-facing saddle between the Doring and Witte Rivers (Figure 4). When the type material was collected, only 16 mature adult plants were observed at this site. These flowering specimens had escaped a burn that had occurred approximately three years earlier. The original population must have been considerably larger as some 30 seedlings were observed in the area. This species is clearly an exceptionally narrow endemic in common with several other narrow proteaceous endemics from the same area, like *Serruria williamsii* and *Sorocephalus alopecurus*.

**Biology:** *Leucadendron immoderatum* is a serotinous, non-lignotuberous seed regenerator. Seedling development in the post-fire phase appears to be slow, eventually resulting in the development of a dense, highly divaricate mat-like shrub,  $\pm 0.7$  m tall and up to 2 m in diameter, consisting of several main branches bearing numerous slender axillary branchlets covered with slightly glaucous, acicular-terete leaves.

After persisting for several years in this juvenile non-reproductive phase, a number of stout, erect, unbranched, abruptly emergent shoots are produced from the main

basal branches, bearing a graduated series of acicular to linear-oblong to oblanceolate leaves. These 1 m long reproductive shoots consist of up to three annual growth increments, some increments elongating by over 500 mm in one year. This is in marked contrast to the very short annual growth increments on the basal sterile branchlets. Male or female cones surrounded by broadly obovate leaves terminate these heavy, woody stems. Thereafter annual growth slows dramatically but is continued by a number of very short (80–100 mm long) axillary branches arising below the terminal cones.

Flowering occurs in early summer, peaking between the first and third weeks of November. Large numbers of small, unidentified Diptera and Coleoptera as well as large scarab beetles (*Trichostetha* sp.) were observed on both male and female inflorescences, apparently effecting cross-pollination.

**Conservation status:** unless additional populations are discovered, *L. immoderatum* must rank among the rarest species in the genus. With under 20 adult plants and fewer than 50 seedlings seen at the time of making the type collection, it is clearly a naturally rare, very local endemic, but currently not threatened by any obvious human activities due to its isolated, somewhat inaccessible montane habitat. As a slow maturing species, too frequent fires seem to be the only immediate threat to its survival.

Other specimen examined

WESTERN CAPE.—3319 (Worcester): northwest side of Olifantsberg, ENE of saddle between Doring and Witte Rivers, (–CD), 22-3-2001, A.G. Rebelo Y1032106 (NBG, PRE).

ACKNOWLEDGEMENTS

I am most grateful to Tony Rebelo for showing me the only known population of this species in the field and to Colin Paterson-Jones who accompanied us and took the photographs in Figure 4. Inge Oliver prepared the excellent line drawings of male and female inflorescences.

REFERENCE

WILLIAMS, I.J.M. 1972. A revision of the genus *Leucadendron* (Proteaceae). *Contributions from the Bolus Herbarium* No. 3.

J.P. ROURKE\*

\* Formerly: Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, 7735 Claremont, Cape Town.

AMARYLLIDACEAE

A NEW VARIETY IN THE GENUS *CLIVIA*

The current classification for *Clivia* Lindl., a genus endemic to southern Africa, recognizes five species of which only one is infraspecifically divided into varieties (Duncan 1999; Rourke 2002; Snijman & Archer 2003; Swanevelder 2003). A still undescribed sixth species from the Pondoland Centre of Endemism (Van Wyk &

Smith 2001) is currently under investigation (Swanevelder 2003). *Clivia miniata* (Lindl.) Regel var. *citrina* Watson was discovered in the latter part of the 19th century and, on the basis of its yellow flowers, described by W. Watson as a variety in 1899 (Watson 1899; Phillips 1931; Duncan 1985, 1992). Strictly speaking the rank of

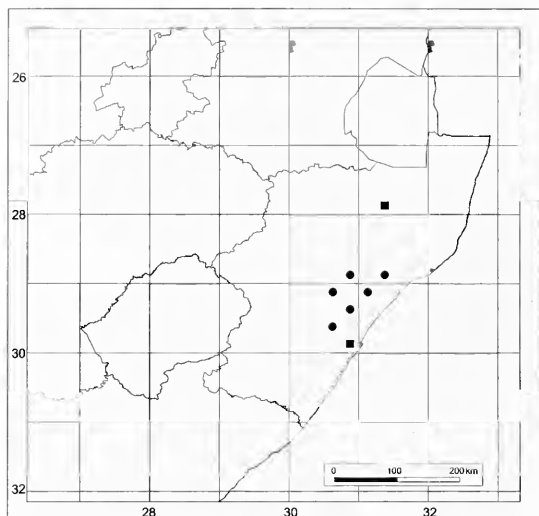


FIGURE 5.—Distribution of *C. gardenii* var. *gardenii*, ●, and *C. gardenii* var. *citrina* as well as the typical variety, ■.

forma should have been used for the sporadic occurrence of the single colour mutation to which this variety name applies (Stuessy 1990). Here we formally describe a distinct yellow-flowered form of *Clivia gardenii* Hook. Following the precedent set in *Clivia miniata*, we have decided to recognize the new infraspecific taxon at variety level. For a complete description of *C. gardenii*, see Hooker (1856).

***Clivia gardenii* Hook. var. *citrina* Z.H.Swanevel-der, A.E.van Wyk & J.T.Truter, var. nov., floribus pallide luteis vel citrinis, non aurantiacis vel rubris ut in varietate typico distinguitur.**

**TYPE.**—KwaZulu-Natal, 2731 (Louwsburg): Ngome Forest, (–CD), Swanevel-der & Truter ZH10 (PRU, holo.).

**Flowers** pale yellow or lemon yellow, not orange or red as in the typical variety.

The holotype of *C. gardenii* var. *citrina* was collected in Ngome Forest (Ngotshe District, KwaZulu-Natal) on 22 June 2002. Visits to the forest confirmed previous reports of a strong population of lemon- or pale yellow-flowered *C. gardenii*, with the occasional pastel or orange-flowered individual, at this locality. This stands in contrast to the single yellow-flowered specimen of *Clivia miniata* that was available when the variety *citrina* was described. We therefore consider the establishment of a new yellow-flowered variety in *Clivia gardenii* as fully justified.

In *C. gardenii* var. *gardenii* the flowers are various shades of orange and red (Obermeyer 1972). We treat all plants with flowers in shades of these two colours (at the time of anthesis), as belonging to this variety. *Clivia gardenii*, as defined by Swanevel-der (2003), is confined to two disjunct areas in KwaZulu-Natal (Figure 5). Plants from southern KwaZulu-Natal and adjacent parts of Eastern Cape traditionally identified as *C. gardenii* are now regarded as a new taxon and have been excluded from the distribution of *C. gardenii* (Swanevel-der 2003).

The main distribution range of *C. gardenii* extends from Durban northwards to Empangeni and inland as far as Kranskop, Greytown and Howick. A second outlier distribution area is located in the Ngome Forest between Vryheid and Nongoma, and slightly further north. No linking records were found between these two distribution areas.

Ngome Forest is part of the Ntendeka Wilderness Area and the yellow-flowered plants are all confined to this protected area. The population is healthy with a high percentage of plants producing flowers and seed. Hopefully the relative inaccessibility of the plants would ensure the survival of the population as it provides some protection against illegal plant collecting. The conservation status of the new variety on Table Mountain near Pietermaritzburg is unknown as no additional herbarium specimens of this taxon have been collected from there since 1949.

#### Additional material examined

KWAZULU-NATAL.—2731 (Louwsburg): Ngome Forest, south-facing gully about 100 m east of campsite, (–CD), June 1999, Rourke 2157 (NBG). 2930 (Pietermaritzburg): Table Mountain, Amatulu Forest, (–DA), 28-05-1949, Killick 466 (PRE, NH).

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## SCROPHULARIACEAE

*NEMESIA ZIMBABWENSIS*, A NEW RECORD FOR THE FSA REGION WITH NOTES ON ITS PHYTOGEOGRAPHICAL SIGNIFICANCE

Since its description by Rendle (1932), and subsequent treatment in the *Flora zambesiaca* (Philcox 1990), *Nemesia zimbabweensis* Rendle (= *N. montana* Norl.) was known only from the Masvingo District and Eastern Highlands of Zimbabwe and the adjacent high-altitude area of Gorongosa in Mozambique. The oldest known herbarium collection of the species dates from 1929 when Rendle collected the type specimen at Great Zimbabwe, Masvingo District.

***Nemesia zimbabweensis* Rendle** in *Journal of Botany* 70: 95 (1932). Type: Zimbabwe, Great Zimbabwe, Rendle 329 n.v. (BM, holo.).

*Nemesia montana* Norl.: 100 (1951). Type: Zimbabwe, Mt Inyangani, Fries, Norlindh & Weimark 3586 (LD, holo.; K, PRE!, iso.).

Philcox (1990) considered *Nemesia montana* Norl. (Norlindh & Weimark 1951) as conspecific with *N. zimbabweensis*. Originally *N. montana* was characterized as a perennial with sessile to shortly petiolate (up to 3 mm long) leaves, and *N. zimbabweensis* as an annual with petioles 3–7 mm long. Philcox (1990) pointed out that both sessile and petiolate leaves may occur on the same specimen, hence his recognition of only a single species, described by him as either annual or biennial. Within its range the species is easily distinguished from other members of the genus by its broadly ovate leaves. Herbarium specimens of plants from shady or marshy habitats have weakly branched herbaceous stems with relatively long internodes and tend to have sessile leaves. This creates the impression that they are annuals. Plants from more exposed habitats, for example rock crevices or regularly burned grassland along forest edges, are often more branched and tend to have distinctly stalked leaves; they clearly are short-lived perennials.

Recent collecting in the province of Limpopo, South Africa, has confirmed the presence of *N. zimbabweensis* in the Leolo Mountains, Sekhukhuneland, where it was recorded on 4 December 1999 (Van Wyk & Siebert 13454 in PRU). A study of the *Nemesia* material in the National Herbarium (PRE), Pretoria, has subsequently revealed three earlier collections of the same species from Afromontane vegetation along the Great Escarpment to the north of the Leolo Mountains, near Haenertsburg, also in Limpopo. The last-named three collections have sessile leaves and were provisionally determined as showing affinity to *N. montana* by Prof. O.M. Hilliard in 1985. These records confirm the presence of *N. zimbabweensis* in the FSA region and show a clear disjunction of  $\pm 400$  km from the nearest existing record at Great Zimbabwe (Figure 6).

On the Leolo Mountains, *N. zimbabweensis* is currently only known from a single patch of relict Afromontane Forest associated with rocky outcrops at an altitude of 1 800 m asl (Siebert *et al.* 2003). The mean annual rainfall is  $\pm 900$  mm and mist occurs frequently. Here it occurs as a lithophyte, with plants sparsely distributed along moist, rocky ledges in the forest where they grow in pockets of sandy humus. At this locality the leaves are

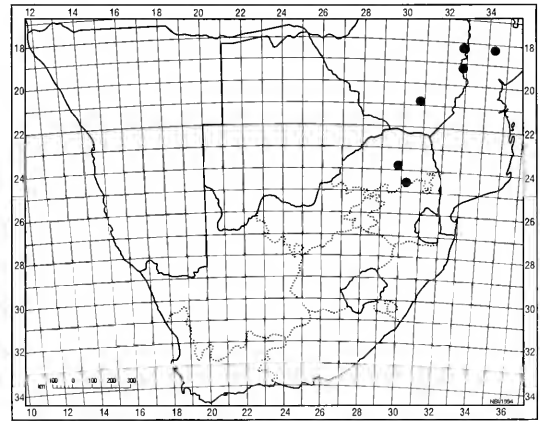


FIGURE 6.—Known distribution of *Nemesia zimbabweensis*.

mainly distinctly petiolate. Plants tend to branch basally and are clearly short-lived perennials. The flowers are white, often tinged with lilac, and the nectar guides are dark purple. In all the Limpopo collections of this taxon, there is a complete lack of long glandular trichomes on the calyx lobes (Figure 7). These trichomes are characteristically present in plants from Zimbabwe and Mozambique.

The Leolo Mountains fall within the core area of the Sekhukhuneland Centre of Plant Endemism [SC] (Siebert *et al.* 2003). Intriguing disjunct distributions between the SC and parts of Zimbabwe have also been recorded in other species, for example *Melhanian randii* (Verdoorn 1981), *Plectranthus venterii* (Edwards *et al.* 2000), *P. dolomiticus* (Edwards *et al.* 2001) and *Raphionacme chimanimaniana* (Victor 2002). In addition, the SC also shows disjunct plant distributions with other regions of South Africa, for instance with Eastern Cape (forms of *Asparagus intricatus* and *Schotia latifolia*), Griqualand West in Northern Cape (*Gnidia polycephala* and *Nuxia gracilis*), the Limpopo River Valley further north in Limpopo (*Decorsea schlechteri* and *Sesamothamnus lugardii*) and North-West (*Amphiglossa triflora* and *Rhigozum obovatum*). The SC is therefore not only of special biogeographical significance for its high levels of local endemism, but also for the observation that it seems to have served as a refuge/repository for relict plant taxa perhaps dating from several different episodes of climatically-induced vegetational shifts over a long period of time.

Owing to the restricted distributions of the Sekhukhuneland-Zimbabwe disjuncts, the threat status of these taxa has been assessed, namely *Melhanian randii* (Sterculiaceae), *Plectranthus venterii* (Lamiaceae) and *Raphionacme chimanimaniana* (Apocynaceae) are all considered as Vulnerable (Siebert *et al.* 2002; Victor 2002). Hilton-Taylor (1996) considered *Plectranthus dolomiticus* (Lamiaceae) as Insufficiently Known. Siebert *et al.* (2002) provisionally assessed *N. zimbabweensis* as Critically Endangered in South Africa owing to the ongoing destruction



FIGURE 7.—A, *Nemesia zimbabweensis*, Van Wyk & Siebert 13454 in PRU. Specimen collected on the Leolo Mountains, Sekhukuneland; B, note complete lack of long glandular trichomes on calyx lobes. Scale bars: A, 20 mm; B, 5 mm.

by humans of the particular forest patches where it occurs. For instance, a new and more accessible road has been built to the summit of the Leolo Mountains and wood harvesters are now felling the last remaining large trees of *Prunus africana* and *Kiggelaria africana*. In due course the forest microclimate will change and *N. zimbabweensis* will probably disappear. The Woodbush and Haenertsburg collections date from 1913, 1935 and 1954 respectively. Since then, agriculture and the large-scale establishment of alien tree plantations have destroyed much of the natural grassland and associated wetland vegetation in these two areas. The lack of any recent collections from this area suggests that the species is either very rare, or extirpated due to habitat destruction.

There is an urgent need to assess the conservation status, not only of rare plant species, but also that of the rare

plant communities that harbour disjunct satellite populations of these taxa. In addition to their considerable biogeographical significance, outlier populations may also represent distinct ecotypes worthy not only of protection, but perhaps even formal taxonomic recognition at the infraspecific level. In this regard it is noteworthy that the Limpopo collections of *N. zimbabweensis* differ from their northern counterparts in the complete lack of long glandular trichomes (Figure 7B). Plants from Zimbabwe and Mozambique are sparsely glandular-pubescent, the long trichomes being most consistently present on the calyx, the lobes of which are ciliate. Although the Limpopo plants appear to be glabrous, minute, almost sessile, glandular trichomes with globose heads are present, especially on the lower surface of young leaves. These structures are visible only under very high magnification (40×) with a dissection microscope and although

not previously reported, seem to be present in material from the whole range of the species.

### Specimens examined

LIMPOPO.—2329 (Pietersburg): Woodbush, Mountain Home Farm, (–DD), *Mogg* 14684 (PRE); 1 mile north of Haenertsburg, (–DD), *Codd* 8418 (PRE); Haenertsburg, (–DD), *Pott* 4813 (PRE). 2430 (Pilgrim's Rest): summit of Leolo Mountains, (–CA), *Van Wyk & Siebert* 13454 (PRE, PRU).

ZIMBABWE.—1832 (Mutare): Inyanga [Nyanga] Dist., Gairesi Ranch on P.E.A. border 6 miles north of Troutbeck, (–BB), *Robinson* 1979 (PRE, SRGH); Inyanga [Nyamga] Dist., Mount Inyangani [Nyangani], (–BD), *Goodier & Phipps* 68 (PRE, SRGH), *Fries, Norlindh & Weimarck* 3586 (PRE), *Sturgeon s.n.* *GHS*16956 (K, SRGH), *Watmough* 740 (PRE); Inyanga [Nyanga], (–BD), *Norlindh & Weimarck* 4557 (PRE). 1932 (Melssetter): Vumba [Bvumba] Mountains, (–BB), *Ferrar* 3952, 3953 (PRE), *Obermeyer* 2147 (PRE). 2030 (Masvingo): Masvingo Dist., Great Zimbabwe, (–BD), *Balsinhas & Kersberg* 2179 (LMA, PRE), *Wild* 3036 (K, SRGH).

MOZAMBIQUE.—1834 (Vila Paiva de Andrada): Gorongosa, Mount Gogogo, (–AC), *Schelpé* 444 (BM).

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## IRIDACEAE

### TAXONOMIC NOTES ON *BABIANA* AND *FERRARIA* IN ARID WESTERN SOUTHERN AFRICA

In preparation for an account of the Iridaceae for Namaqualand and the winter rainfall Karoo, we have found that several nomenclatural and taxonomic adjustments are necessary. These concern the genera *Babiana* Ker Gawl. and *Ferraria* Burm. ex Mill. Both genera are currently being actively studied but our conclusions will not be published in the immediate future.

### Taxonomic notes on *Babiana*

***Babiana spiralis* Baker**, Handbook of the Iridaceae: 111 (1892). Type: South Africa, Northern Cape, Namaqualand, without precise locality or date, collector uncertain, possibly *J. Niven s.n.* in Herb. Forsyth (K, syn.!: 2 sheets).

*Babiana fimbriata* was first collected by J.F. Drège in 1830 in Namaqualand between the Swartdoorn and Groen Rivers, between Bitterfontein and present day Garies. It was assigned to the genus *Antholyza* by F.W. Klatt in 1867, 1868 and was transferred to *Babiana* by J.G. Baker in 1877. Then, in her monograph of *Babiana*, G.J. Lewis (1959) included as a synonym of *B. fimbriata*, a second species, *B. spiralis*, which had been described by Baker in 1892. In *Flora capensis*, Baker (1896) recognized both *B. fimbriata* and *B. spiralis*. Our field work in Namaqualand

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over the past 10 years shows that Baker was correct in recognizing both species. They are readily distinguished from each other by vegetative and floral features. Normally a fairly tall plant, standing 250–550 mm high, *B. spiralis* has a velvety hairy stem and smooth cataphylls and leaf sheaths. The leaf blades are 1.5–2.5 mm wide and loosely twisted above with a distinct pseudopetiole up to 40 mm long. The flowers are coloured bright pink or pale blue with pale yellow nectar guides on the lower tepals, which have auriculate lobes at the base of the limbs. The upper lateral tepals curve outward shortly above the base and are thereafter subpatent.

In contrast, *Babiana fimbriata* is 100–200 mm tall, with a hairless or nearly hairless stem and cobwebby to woolly cataphylls and leaf sheaths. The leaf blades are 3–4 mm wide. The flowers are dull purple and cream-coloured and the lower lateral tepals also have prominent auriculate lobes at the base of the limbs. The upper lateral tepals are directed forward or slightly curved inward in the proximal half, giving the flower a distinctly closed appearance in comparison with that of *B. spiralis*.

Favouring deep sandy soils, *Babiana spiralis* is the more widespread of the two species, extending from Garies to Klawer in the south and along the coast



between Groen River mouth and Kotzesrus in the west. *B. fimbriata*, in contrast, is a fairly narrow endemic of central Namaqualand, with a range limited to the area between Garies and Nuwerus, and seems to prefer stony ground rather than deep sands.

The only collection of *Babiana fimbriata* correctly assigned to the species by Lewis (1959) is the type gathering. Other specimens that she cited are *B. spiralis*. Since the publication of her monograph, a handful of additional collections have been made of plants corresponding to the original Drège collection and they show beyond question that *B. fimbriata* is distinct from *B. spiralis*. The origin of the type collection of *Babiana spiralis* has long been puzzling. The name Forsyth on the type sheets at the Kew Herbarium is now thought to refer to William Forsyth, whose herbarium collection was bought in 1835 after his death by George Bentham of Kew Gardens (C.E. Nelson pers. comm. 2003). We suspect that the specimens were actually collected by James Niven, who botanized in Namaqualand in 1799 and possibly later, gathering seeds and perhaps bulbs, for patrons in Great Britain and France (Gunn & Codd 1981).

#### Material examined

##### *Babiana fimbriata*

NORTHERN CAPE.—3017 (Hondeklipbaai): 550 m ESE of Waterklip from Grootbrakfontein, near Garies, (–DB), August 1979, *Van Berkel* 129 (NBG).

WESTERN CAPE.—3018 (Kamiesberg): between Bitterfontein and Garies at Swartdoring River, (–CC), 2 September 2000, *Goldblatt & Nänni* 11452 (MO, NBG, PRE); 9 km N of Bitterfontein, (–CC), 20 August 2001, *Goldblatt & Porter* 11711 (MO, NBG). 3118 (Vanrhynsdorp): Meerhofkasteel Farm, 15 km W of Nuwerus, (–AA), 28 August 1986, *Hilton-Taylor* 1203 (NBG); 3 miles NW of Nuwerus, (–AB), 11 September 1971, *Hall* 4141 (NBG); between Nuwerus and Lutzville, (–AB), 17 July 1964, *Lewis s.n.* (NBG); rocky bank between Bitterfontein and Nuwerus, (–AB), 13 August 1997, *Goldblatt & Manning* 10666 (MO); Knersvlakte at Grootgraafwater turnoff, stony east-facing slope, (–BC), 20 August 2001 (fr.), *Goldblatt & Manning* 11710 (MO).

##### *Babiana spiralis*

NORTHERN CAPE.—3017 (Hondeklipbaai): lat. 30°32'67", long. 17°56'80", (–DB), 26 April 1981, *Van Berkel* 378 (NBG); hills above Garies, 4 August 1980, *Greig & De Villiers* 2 (PRE); 18 km from the junction of the Garies–Groenrivier road toward Nuwefontein, (–DC), 3 September 1976, *Boucher* 3159 (K, NBG, PRE); Farm Waterval west of Kotzesrus, (–DC), 28 August 2001, *Goldblatt & Porter* 11773 (MO, NBG); sandy flats 1.8 km east of Kotzesrus, (–DC), *Goldblatt & Porter* 12080 (MO, NBG); top of Garies hill, ± 0.5 km along road to Hondeklipbaai, (–DB), 2 September 2000, *Goldblatt & Nänni* 11453 (K, MO, NBG, PRE); 18 km towards Nuwefontein from junction with Garies–Groenrivier road, (–DC), 3 September 1976, *Boucher* 3159 (K, NBG, PRE); Farm Waterval, 14 km W of Kotzesrus, (–DC), 28 August 2001 (fr.), *Goldblatt & Porter* 11772 (MO, NBG).

WESTERN CAPE.—3118 (Vanrhynsdorp): hills at Bitterfontein, (–AA), 2 September 1897, *Schlechter* 11041 (K, MO, S); SW of Bitterfontein, (–AB), 5 September 1955, *Hall* 1003 (NBG); Klawer, (–DC), July 1848, *Stokoe s.n.* (SAM59866).

Locality uncertain: 1 km SW of Biesiesfontein, September 1974, *Nordenstam & Lundgren* 1770 (MO, S).

***Babiana planifolia* (G.J.Lewis) Goldblatt & J.C.Manning**, comb. et stat. nov.

*Babiana striata* var. *planifolia* G.J.Lewis in Journal of South African Botany, Suppl. 3: 130 (1959). Type: South Africa, Northern

Cape, 9 miles (14.4 km) west of Steinkopf, 30 June 1935, *T.M. Salter* 5554 (BOL, holo.!).

Although only two collections were known to Lewis (1959) when she described *Babiana striata* var. *planifolia*, several additional gatherings are now available and make it clear that this taxon is best treated as a separate species. Typical *B. striata* has a strongly inclined stem and nearly horizontal spike, conspicuously undulate and crisped leaves, and corm tunics of coarse fibres. What we now recognize as *B. planifolia* has an erect stem and only slightly inclined spike, almost plane leaves that are only occasionally weakly undulate toward the base and loosely twisted distally, and corm tunics of relatively fine fibres. Plants of both taxa have cobwebby to woolly cataphylls and lower leaf sheaths, and the stem and bracts are usually hairless. The lower lateral tepals of *B. planifolia* also appear to lack the exaggerated auricular lobes at the base of the limbs typical of most other species of section *Exohebeoides*, including typical *B. striata*.

Plants from the Eksteenfontein area of the southern Richtersveld associated with *Babiana planifolia* (as *B. striata* var. *planifolia*) by Lewis have short, broad, weakly undulate leaves 35–50 × 15–20 mm, twisted in the upper half. These plants seem to differ consistently in their short stature and additionally have long, soft, almost silky hairs on the leaf margins and upper sheaths, especially conspicuous in *Goldblatt & Manning* 9898 (MO, NBG). Although corms, cataphylls, and the lower leaf sheaths of the Richtersveld plants are not known, we provisionally include this form in *B. planifolia*. Additional material may show that it is a separate taxon.

Both *Babiana striata* and *B. planifolia* flower in May and June, occasionally in July, and remain poorly represented in herbaria, although neither is rare in the wild. *Babiana planifolia* grows on rocky slopes, mainly on fine-grained soils, extending from the southern Richtersveld to Garies and Soebatsfontein and locally in the Knersvlakte.

#### Other material examined

NORTHERN CAPE.—2817 (Vioolsdrif): 3 km N of Eksteenfontein, (–CD), 3 August 1994, *Goldblatt & Manning* 9898 (MO, NBG); near Eksteenfontein, (–CD), 27 March 1979, *Van Berkel* 100 (NBG). 2917 (Springbok): 23 miles W of Steinkopf, (–AB), June 1929, *Marloth* 13254 (PRE); 26 km west of Springbok, Spektakel Pass, in granitic ground, (–DA), 22 July 1976, *Goldblatt* 3658 (MO); Ezelfontein, 14 miles west of Springbok, (–DA), 20 June 1965, *Hall* 3057 (NBG); near Paddagat, 22 miles NW of Springbok, (–DB), 28 May 1961, *Leistner* 2552 (NBG, PRE); 14 km S of Springbok, (–DD), 7 August 2000 (fr.), *Goldblatt & Manning* 11327 (MO, NBG). 3017 (Hondeklipbaai): 10 km N of Soebatsfontein, (–BA), 21 May 1986, *Duncan* 114 (NBG); 14 miles NW of Kamieskroon, (–BB), 19 July 1957, *Acoks* 19323 (PRE); road to Hondeklipbaai near turnoff N of Garies, (–DB), May–June, *Loubser* 2160 (NBG); 19 km S of Kotzesrus on road to Landplaas, (–DD), 16 September 2001 (fr.), *Goldblatt & Porter* 11898 (MO, NBG).

WESTERN CAPE.—3118 (Vanrhynsdorp): Knersvlakte at Grootgraafwater turnoff, stony east-facing slope, (–BC), 20 August 2001 (fr.), *Goldblatt & Manning* 11710A (MO).

#### Taxonomy of the *Ferraria divaricata* complex

When M.P. de Vos revised the southern African genus *Ferraria* in 1979, she treated *F. divaricata* as a single

widespread species with four subspecies. The entire range of the species extended from southwestern Namibia to the southern Cape, and locally eastward into the Karoo. Two subspecies, subsp. *arenosa* and subsp. *aurea* were distinguished by a well-developed aerial stem, usually extensively branched in the upper half and flowers lasting a single day, whereas subsp. *divaricata* and subsp. *variabilis* have short stems, branching to some extent, but usually close to ground level and the flowers last two, exceptionally three days. De Vos (1979) also noted differences in the seeds between the two pairs of subspecies, subsp. *arenosa* and subsp. *aurea* having globose, matte brown seeds with reticulate sculpturing and foveate epidermal cells, whereas subsp. *divaricata* and subsp. *variabilis* have seeds typical of the rest of the genus, being irregularly angled by pressure and pale straw-brown in colour with a coat that is slightly wrinkled to ruminate.

Uniting the four subspecies is a similarity in floral morphology, viz. the tepals have broad claws that together form a wide floral cup, while the fringed tepal limbs extend horizontally. The floral cup, 12–15 mm deep and 13–15 mm wide at the rim, holds a pool of nectar secreted from small nectaries a short distance above the tepal bases. *Ferraria divaricata* belongs in section *Macroscyphae* of the genus, defined by a beaked ovary and capsule and anthers with divaricate lobes. Other species of the section, including the Namaqualand *F. macrochlamys* (Baker) Goldblatt & J.C.Manning (Goldblatt & Manning 2004) and *F. kamiesbergensis* M.P.de Vos, and the Western Cape *F. uncinata* Sweet, have relatively narrow tepal claws that form a narrow cup and smaller flowers.

After collecting plants of all four subspecies in the field, we have become dissatisfied with this taxonomy. The tall-stemmed subsp. *arenosa* and subsp. *aurea*, which together have a distribution along the Cape west coast from Hondeklipbaai in the north to the Cape Flats in the south, have seeds unique in *Ferraria*, as well as a tall, branched habit, and flowers lasting a single day and differing in coloration from those of subsp. *divaricata* and subsp. *australis*, which last two or three days. A taxonomy that better reflects the biological situation is to treat subsp. *arenosa* and subsp. *aurea* as one species, and subsp. *australis* and subsp. *divaricata* as another.

A second consideration relating to *Ferraria divaricata* is the typification of the species. The type is an illustration in *The British flower garden* (Sweet 1827), which depicts a branch of a plant described as being 18 inches (0.45 m) high, with chocolate-brown flowers with a pale, darkly streaked floral cup. This matches exactly, populations of the plant currently called *F. divaricata* subsp. *arenosa* from the Western Cape coast near Leipoldville and Sandberg (see Manning *et al.* 2002: 158, as *F. foliosa*). It follows that subsp. *arenosa* and subsp. *aurea*, when raised to species rank, must be called *F. divaricata*. This means that subsp. *australis* and subsp. *divaricata* need a new name. There are no legitimate synonyms available at species rank. The only synonym, *F. antherosa* Ker Gawl., is a superfluous name for *F. viridiflora* Andr. which is itself a synonym of *F. ferrariola* (Jacq.) Willd. We chose the name *F. variabilis* for the species in view of the variable perianth coloration. This

ranges from red-brown tepal limbs with dull purple at the base and pale claws (subsp. *divaricata*) to variously greenish, dull yellow, or light brown with speckled markings on the limb bases (subsp. *australis*). Basic chromosome number is  $x = 10$  in *F. divaricata* and *F. variabilis*. All counts are diploid,  $2n = 20$ , except in populations referred by De Vos (1979) to *F. divaricata* subsp. *australis*, which are tetraploid,  $2n = 40$ . We see no need to distinguish subspecies within *F. divaricata* and *F. variabilis*, based largely on tepal colour and patterning (and chromosome number in the case of subsp. *australis*), and thus recognize just two species in place of *F. divaricata* and De Vos's four subspecies.

***Ferraria divaricata* Sweet**, *The British flower garden* 1: t. 192 (1827); M.P.de Vos : 354 (1979). Type: illustration in Sweet, *The British flower garden* 1: t. 192 (1827), from South Africa, without precise locality, collected by W. Synnot.

*F. divaricata* subsp. *arenosa* M.P.de Vos 45: 358 (1979). Type: South Africa, [Western Cape], Clanwilliam, Nardouw Pass, Farm de Lille, October 1973, *Van Breda sub De Vos* 2295 (STE, holo.!).

*F. divaricata* subsp. *aurea* M.P.de Vos 45: 359 (1979). Type: South Africa, [Western Cape], 15 miles east of Lambert's Bay, Langdam, 28 September 1973, *De Vos* 2297 (STE, holo.!).

***Ferraria variabilis* Goldblatt & J.C.Manning**, sp. nov.

*F. antherosa* Ker Gawl. : t. 751 (1804), nom. illeg. superfl. pro *F. viridiflora* [as *F. viridis*] Andrews. Type: South Africa, without precise locality or collector, illustration in Curtis's *Botanical Magazine* 20: t. 751 (1804).

*F. divaricata* subsp. *australis* M.P.de Vos 45: 359 (1979). Type: South Africa, [Western Cape], Clanwilliam, Langdam, 17 September 1945, *R.H. Compton* 17412 (NBG, holo.!).

Plantae 60–200 mm altae saepe caespitosae, prope basem ramosae, foliis ensiformibus ad linearibus, rhipidiis 2-florum spatha interiore 40–80 mm longo exteriore usitate pauce brevior, floribus usitate limbis pallide flavis ad brunneis vel griseocaeeruleis marginibus coloribus pallidior vel atrobrunneis unguibus pallidis vel atrostriatis cupulatis, tepalis exterioribus 27–40(–50) × 10–15 mm, interioribus 25–40(–45) × 8–10 mm, unguibus 10–15 mm longis, filamentis connatis in columnam 8–13 mm longis liberibus divergentibusque 3–4 mm, antheris 3.5–5.0 mm longis lobis late divergentibus, ovario rostrato, capsulis ellipsoideis 30–50 mm longis.

TYPE.—Northern Cape, 3119 (Calvinia): Nieuwoudtville, Klipkoppies, lower slopes in sand, (–AC), 15 September 1961, *W.F. Barker* 9537 (NBG, holo.!, MO, iso.!).

Plants 60–200 mm tall, often branched just above base, branches crowded and subequal in length, often forming small tufts. *Leaves* sword-shaped to linear, usually about as long as stem, sometimes up to twice as long, (2–)4–10 mm wide, crowded basally, usually without visible midrib, often slightly striate, margins often weakly thickened, rarely obscurely crisped, sheaths usually overlapping and concealing stem. *Rhipidia* 2-flowered; inner spathes 40–80 mm long, outer slightly shorter to about as

long, often arching outward in upper half. *Flowers* lasting two or sometimes three days, predominantly pale to dull yellowish to pale to middle brown, or dull grey-blue, limbs solid dark brown to blackish purple at base, or with scattered dark spots, margins darker or paler in colour, claws uniformly pale or with dark longitudinal streaks or with broad darker median streak, forming floral cup 12–15 mm deep, 13–15 mm wide at rim, usually slightly putrid smelling, nectaries basal, pale or dark-coloured; outer tepals 27–40(–50) × 10–15 mm, claws 10–15 mm long, inner tepals 25–40(–45) × 8–10 mm. *Filaments* united in column 8–13 mm long, free and arching outward in upper 2–4 mm; anthers 3.5–5.0 mm long before anthesis, shorter after dehiscence, lobes widely diverging. *Ovary* with sterile beak; stigmas comprising small lobes below tips of style arms, arching over anthers. *Capsule* ellipsoid, 35–50 mm long, including beak; seeds rounded, usually angled by pressure, coat dull and slightly wrinkled. *Flowering time*: August to November.

*Distribution and ecology*: sandy and shale flats and granite outcrops, extending from southern Namibia to Oudtshoorn and into the Upper Karoo as far east as Upington and Britstown, but absent from the western coastal forelands of Western Cape.

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## LYCOPERDACEAE—GASTEROMYCETES

### BOVISTA CAPENSIS, THE CORRECT NAME FOR BOVISTA PROMONTORII

In 1822 the botanical collector Carl Zeyher arrived at the Cape of Good Hope with the purpose of collecting mainly higher plants (Gunn & Codd 1981). Although he initially had no interest in fungi, he amassed a fairly extensive collection of macrofungi during his sojourn in Uitenhage (near Port Elizabeth), Eastern Cape, during the 1830s. Most of Zeyher's fungal material was later studied by the Rev. M.J. Berkeley in England, but some specimens also found their way to E.M. Fries in Uppsala, Sweden. It was from the latter material [*Zeyher 106 sub herb. E. Fries* (UPS)] that Fries (1848) established *Lycoperdon capense*, a new species accompanied by a brief and rather ambiguous description. In a review of South African Gasteromycetes, Bottomley (1948) was unable to ascertain the identity of *L. capense* Fr. and included it in her list of 'Doubtful, unknown and insufficiently described species'.

In his classic monograph of the genus *Lycoperdon* Pers.: Pers., Demoulin (1971) correctly excluded *Lycoperdon capense* from that genus and speculated that it probably represented a species of *Vascellum* F.Šmarda. He overlooked the fact, however, that earlier, Kreisel (1967: 106) had pointed out that *Zeyher 106* at UPS is a mixed collection, consisting of a *Bovista* Pers.: Pers. as

well as a *Calvatia* Fr. element. The two elements of *Zeyher 106* have subsequently been split and are now filed in separate folders at UPS, with the *Bovista* and *Calvatia* parts having been assigned the numbers *Zeyher 106a* and *Zeyher 106b* respectively. The numbers on *Zeyher* specimens can be a source of confusion (Gunn & Codd 1981). In some cases the number on the label may be Zeyher's collecting number but, most commonly, the number refers to the collecting locality, with the second part (if a double number) referring to the month of collection. Therefore, specimens from the same locality may belong to different gatherings, as seems to be the case with *Zeyher 106*. Locality 106 is listed in Gunn & Codd (1981) as 'Uitenhage, Zuureberg, 2-3000'. [Note: in addition to the specimens at UPS, *Zeyher 106* consists also of a third element, on which Berkeley (1843) based the genus *Scolecocarpus* (= *Arachnion* Schwein.) and species *Scolecocarpus tener* Berk. This third element, originally from the herbarium of W.J. Hooker, has not been examined by us but is in all probability still at K, where it had been studied by Demoulin (1972).]

Despite the inadequacy of the original diagnosis of *Lycoperdon capense*, reading it creates the distinct impression that it applies to the *Bovista* part of *Zeyher 106* rather

than the *Calvatia* part. Bottomley (1948) provided the following translation of Fries's original diagnosis: 'Peridium has the habit of *L. gemmatum* but the structure rather of *L. pusillum*. Exoperidium granular. Endoperidium membranous, flaccid, opening by a small, obtuse mouth. Sterile base wanting. Capillitium threads very lax. Spores brown, not becoming olivaceous'. This description also corresponds well with that provided by Kreisel (1967) for the *Bovista* element (now *Zeyher 106a*): 'Endoperidie papierstark, bräunlich, glanzlos; Öffnung unregelmässig eingerissen, ca. 4 mm weit.' and '... Sporenstaub umberbraun ohne Olivton'. A recent examination of the two elements comprising *Zeyher 106* at UPS convinced us that the impression created by Fries's diagnosis is correct and that the original description does indeed apply to the *Bovista*, and not the *Calvatia* gathering. The *Calvatia* element of *Zeyher 106* consists of three specimens, all of which dehisce irregularly in typical *Calvatia* style, not at all by means of 'small mouths' (= pore; ostiole) and with peridial characters irreconcilable with Fries's description. *Zeyher 106a*, however, corresponds well with Fries's original diagnosis, both in terms of the roughness of the exoperidium and the way the endoperidium dehisces. The name *Lycoperdon capense* Fr. therefore clearly applies to the *Bovista* element of *Zeyher 106* and not to *Zeyher 106b*, and in view of that, *Zeyher 106a sub herb. E. Fries* is here designated as lectotype of *Lycoperdon capense* Fr.

In 1967 the *Zeyher 106a* element at UPS served as the basis for the description of a new species, *Bovista promontorii* Kreisel. In his publication, Kreisel (1967) does not refer to the work of Fries (1848), which suggests that he was not aware of Fries's earlier name, *L. capense*. In the light of the above discussion, the new combination *Bovista capensis* is here proposed as the correct name for the *Bovista* element of *Zeyher 106* at UPS and Kreisel's superfluous name is reduced to synonymy:

***Bovista capensis* (Fr.) J.C.Coetzee & A.E.van Wyk, comb. nov.**

*Lycoperdon capense* Fr. in J.A. Wahlbergii Fungi natalenses, adjec-tis quibusdam capensibus: 30 (1848). *Bovista promontorii* Kreisel: 225–226 (1967). Type. South Africa. Pr. B. Sp. [= Promontorium Bonae Spei; = Cape of Good Hope], Uitenhage, *Zeyher 106a sub herb. E. Fries* (UPS!, lecto., here designated).

*L. oblongisporum* auct. non Berk. & Curt.: Lloyd: 235 (1905). [Teste Kreisel (1967) & Ortega & Buendia (1985).]

*L. polymorphum* auct. non Vitt.: Bottomley: 557 (1948). [Teste Kreisel (1967) & Ortega & Buendia (1985).]

Illustrations: Kreisel: figs 17c, 27b' & 58 (1967); Ortega & Buendia: figs 3, 4, 9, 10, 13, 14 (1985).

According to Kreisel (1967) and Ortega & Buendia (1985) the 'South African form' of *Lycoperdon polymorphum* Vitt. [= *Bovista polymorpha* (Vitt.) Kreisel, the correct name of which is *Bovista aestivalis* (Bonord.) Demoulin] *sensu* Bottomley (1948) is conspecific with *Bovista capensis*. Neither Kreisel nor Ortega & Buendia have examined any of the specimens cited in Bottomley (1948), however, and a re-examination of the South African material is required to confirm their assertion. *B. capensis* is separated from *B. aestivalis* only by the shape of its spores (Kreisel 1967), and considering the opinions

of Calonge & Demoulin (1975) and Moyersoen & Demoulin (1996), that in Europe, spore shape does not allow the discrimination of taxa in the *B. aestivalis* complex, the need for a re-assessment of *B. capensis* becomes even more evident. The same applies to the specimens referred to *Lycoperdon oblongisporum* Berk. & Curt. by Lloyd (1905).

Kreisel (1994) cited *Zeyher 106b* under *Calvatia rugosa* (Berk. & M.A.Curtis) D.A.Reid. However, the complete absence of a subgleba and prominent slit-like capillitial wall perforations clearly exclude it from that taxon. We have little doubt that *Zeyher 106b* actually represents an undescribed, but not at all uncommon, South African species belonging to *Calvatia* sect. *Macrocalvatia* Kreisel *sensu* Coetzee & Van Wyk (2003). Followers of Kreisel (1989) would, however, prefer to treat this fungus in the segregate genus *Handkea* Kreisel.

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## LYCOPERDACEAE—GASTEROMYCETES

THE IDENTITY OF *LYCOPERDON COMPLANATUM* DESF. AND ITS NOMENCLATURAL IMPLICATION

## INTRODUCTION

*Lycoperdon complanatum* Desf., nom. illeg. (non Batsch 1786), was established by Desfontaines (1799) to accommodate a fungus growing in arid soil from an unspecified locality in Algeria, North Africa. The taxon still remains known from the original collection only and its taxonomic status has been uncertain ever since it was first described. Desfontaines's original diagnosis is rather cryptic and ambiguous and of no use at all to establish whether *L. complanatum* Desf. actually represented a good species or not: '*Lycoperdon acaule, orbiculatum; superne planum, leave; subtus lacunosum; margine acuto. Orbiculatum, depressum, sessile, planum, superne leave, subtus saepe lacunosum, irregulare; margine acuto, saepe dentate-lacero. Diameter 1–2 decimeter*'. Desfontaines thus merely and, as would later be revealed, quite incorrectly, described it as being a stalkless, flat, round fungus, 100–200 mm diam., with an acute, lacerated margin, flat, smooth upper surface and lacunose lower part. The illustration accompanying the original description (tab. 261, not 161 as cited in the protologue; accessible also through the Missouri Botanical Garden library's rare books web site at <http://ridgwaydb.mobot.org/mobot/rarebooks/>) depicts dorsal (outer surface viewed from above) and lateral views of the specimen, but those are also without any significant diagnostic features.

In view of the illegitimacy of *Lycoperdon complanatum* Desf., Rafinesque's (1814) use of a new epithet was justified—whether intentionally or not—when he treated this fungus as *Omalycus erosus* Raf. Durieu & Léveillé, in Durieu de Maisonneuve (1848), correctly concluded that *L. complanatum* Desf. merely represented the sterile base of a mature puffball of which the peridium had already disintegrated and the gleba was absent. However, as explained in the note at the end of this paragraph, they erred in synonymising it in the protologue with their later (and, in that sense, superfluous and also illegitimate) *L. fontanesii* Durieu & Léveillé. According to Demoulin (1971), as well as our own interpretation of the original material of *L. fontanesii* at the cryptogamic herbarium of the Museum of Natural History in Paris (PC), this latter fungus is the same taxon as *Calvatia utriformis* (Bull.: Pers.) Jaap [or *Handkea utriformis* (Bull.: Pers.) Kreisel, if one prefers to accept the segregate genus *Handkea* Kreisel]. In his classic monograph of the genus *Lycoperdon*, Demoulin (1971) did not provide any further clarity on the identity of *L. complanatum* Desf. and, since he was unaware of the existence of the type material at P while revising *Lycoperdon* Pers.: Pers. at PC (V. Demoulin pers. comm.), he only referred to Desfontaines's original ambiguous illustration. He nevertheless correctly concluded that Desfontaines's fungus could not have been a *Lycoperdon*, but reserved further judgement regarding its true identity. [Explanatory note: *Lycoperdon fontanesii* Durieu & Léveillé is an illegitimate (superfluous) name only because it was synonymised in the protologue with the already existing *L. complanatum* Desf. (the only legitimate name for which, at that stage—and which should have been used in the protologue—was *Omalycus erosus*), not because of the synonymy with

*Calvatia utriformis* (such synonymy gives only the non priority of *L. fontanesii*).]

During a visit to the Botanisches Museum Berlin-Dahlem (B) in 1998, the first author had the opportunity to study Desfontaines's herbarium (P-DESF at P) on microfiche, from which the surprising discovery was made that it included also two sheets of fungi, one of which represented the original material used by Desfontaines in drafting the description of his *Lycoperdon complanatum*. This specimen in P-DESF is a probable holotype (ICBN Art. 9.1, Note 1) but, as is the opinion also of V. Demoulin (pers. comm.), it must rather be regarded as a lectotype since no reasonable proof exists that it really was the only material seen by Desfontaines. It is therefore here designated as such, conforming with ICBN Art. 9.9 (Greuter *et al.* 2000). This material seems to have been overlooked by all investigators since Durieu & Léveillé (1848), although enquiry confirmed that it still existed in good condition in the phanerogamic herbarium (P) of the Museum of Natural History in Paris [and not the cryptogamic herbarium (PC) as might have been expected]. Since Desfontaines's material formed part of the 'historical' collection at P, it was unfortunately not available on loan. A full-colour electronic image of the material was obtained but, although it provided more information than Desfontaines's original illustration, it was still inadequate to allow identification. It did, however, indicate the presence of small bits of glebal tissue still adhering to the base of the specimen, a study of which would certainly throw more light on the identity and status of this fungus. To that purpose the first author undertook a brief study visit to P in 2002, the outcome of which is reported below.

EXAMINATION OF THE LECTOTYPE OF *LYCOPERDON COMPLANATUM* DESF.

**Methodology:** the lectotype was examined macroscopically and microscopically at P-DESF. Macroscopic observations were aided using a 10X magnifying hand lens. Permission was obtained to remove a small tuft of glebal tissue and a tiny piece of endoperidium from the lectotype for microscopic study. The material was mounted in lactophenol with aniline blue and briefly heated over an open flame to determine the cyanophilic reaction as described by Kreisel (1967). Initial microscopic observation at P-DESF was made with a Nikon SE binocular light microscope, but measurements were carried out in the first author's laboratory using a Reichert-Jung Polyvar research microscope. Slides were sealed with clear nail varnish and deposited in the slide collection of the H.G.W.J. Schweickerdt Herbarium (PRU), Department of Botany, University of Pretoria, Pretoria.

**Macroscopic observations:** the lectotype of *L. complanatum* Desf. consists of a single herbarium sheet on which the two halves of a single, vertically sectioned and pressed fungus are mounted, inside and outside surfaces facing respectively. The specimen, that must have measured  $\pm 90$  mm diam. before sectioning, consists only of

the flattened sterile base of a relatively large puffball of which the gleba and surrounding upper section of the peridium had almost completely disintegrated and disappeared. Small amounts of glebal tissue can, however, still be observed in places adhering to the exposed upper surface of the subgleba. Remnants of the basal part of the endoperidium, just above and along the circumference of the subgleba, are also still present. The outer surface of the subgleba is reddish brown with a suede-like texture, but a very thin glossy layer, pale brown in colour and with a metallic sheen, is still present here and there in surface folds. Remnants of what appears to have been part of the exoperidium, now blackish brown, occur near the very base of the specimen. The inner surface of the subgleba is dull greyish brown.

Apart from the name '*Lycoperdon complanatum*', the herbarium label contains no additional information and merely reads: 'Herbier de la FLORE ATLANTIQUE donné au Muséum, par M. DESFONTAINES'. Included also with the lectotype, however, is Desfontaines's (1799) original handwritten description as published in *Flora Atlantica*.

**Microscopic observations:** *capillitium* septate, branched, 2.0–4.5 µm diam., occasionally slightly swollen at septa, terminating in relatively blunt, rounded tips, ± 2 µm diam., disarticulating at or rupturing between septa; *capillitial walls* ± 0.25–0.75 µm thick, appearing smooth and imperforate at first glance but careful observation reveals segments densely pitted with small wall perforations <1 µm wide, immediate cyanophilic reaction not intense but walls staining bright blue over time. *Spores* globose, apedicellate, brownish, poorly cyanophilic, even over time, distinctly verrucose, ornamentation  $\approx$  1 µm high, diameter mostly 5–7 µm without and 6.5–9.0 µm with ornamentation. *Endoperidium* consisting of fragile, positively cyanophilic, branched, septate, often bent and contorted hyphae, breaking up into numerous short fragments when pressure is applied; swollen, short, barrel-, spindle- or irregularly shaped sphaerocyst-like elements present between and continuous with unswollen peridial hyphae.

**Taxonomic conclusion:** after studying the material in P-DESV, the current authors are quite convinced that *L. complanatum* Desf. is conspecific with the common and cosmopolitan puffball, *Calvatia cyathiformis* (Bosc) Morgan, and not with *C. utriformis* (= *Lycoperdon fontanesii*) as has been suggested by Durieu & Léveillé (1848), De Toni (1888) and Mussat (1901). Macroscopically, Desfontaines's material is reminiscent of both *C. utriformis* and *C. cyathiformis*. Microscopically, however, *C. utriformis* is characterized by spores that are smooth under the light microscope and by essentially aseptate capillitium threads with slit-like wall perforations. The septate capillitium threads with numerous small, not slit-like wall perforations, and the distinctly verrucate spores of *L. complanatum* Desf. therefore convincingly distinguish it from *C. utriformis*.

On the other hand, in terms of spore as well as capillitial morphology, Desfontaines's specimen closely matches *C. cyathiformis*, a fungus that we are well acquainted with and which, from the material/records at PC, also seems to be quite common in Algeria. Although a cursory look at the

capillitium of Desfontaines's fungus may create the impression that the walls are not perforated, careful observation reveals many capillitial segments and fragments that are densely pitted with small perforations, identical to and indistinguishable from the capillitium of *C. cyathiformis*. The spore ornamentation of *L. complanatum* Desf. appears to be somewhat more pronounced than what we have become accustomed to in *C. cyathiformis*, but is still within the range as has been described for the latter fungus (Zeller & Smith 1964). A frequently overlooked diagnostic character of *C. cyathiformis* is the occurrence of swollen, often irregularly shaped sphaerocyst-like elements in its endoperidium. In the course of our comparative studies on South African Lycoperdaceae, and in concurrence with the opinion of V. Demoulin (pers. comm.), we have found these elements, previously described in Calonge & Demoulin (1975) and Moyersoen & Demoulin (1996) and adequately illustrated also in Dominguez de Toledo (1993) and Migliozi & Coccia (1999), to be a very constant, reliable and easily observable diagnostic feature of *C. cyathiformis*. Hence the presence of similar cells in the investigated peridium fragment strengthens our conviction that Desfontaines's *L. complanatum* and *C. cyathiformis* are conspecific.

#### NOMENCLATURAL IMPLICATION

When he established the genus *Omalycus*, Rafinesque (1814) also included *Lycoperdon complanatum* Desf. in his new taxon, renaming it *Omalycus erosus* Raf. No original material of *Omalycus violacinus* Raf., the type species of the genus *Omalycus*, has survived, therefore, it has never been possible to determine the taxonomic status of *Omalycus* with certainty. Note, however, that our acceptance of *O. violacinus* as type species is provisional, and follows the interpretation of Farr *et al.* (1979). There is some doubt as to whether the protologue in Rafinesque (1814) provides enough evidence to justify the selection of *O. violacinus* as the type species. Seeing that *O. violacinus* was not explicitly indicated as type species by Rafinesque, and that the genus *Omalycus* was not monotypic when established, then it may be argued that *O. erosus* could, in the light of ICBN Art. 10.1, Note 1, be regarded, by analogy, as a syntype of the genus *Omalycus*. If the latter interpretation is followed, then Farr *et al.* (1979) unintentionally lectotypified *Omalycus*. In view of the existence of original material of *L. complanatum* Desf., the appointment of *O. erosus* (= *L. complanatum* Desf.) as lectotype might have been more appropriate (ICBN Art. 9.10 and Art 10.2).

Although De Toni (1888), relegated *Omalycus* to synonymy under *Scleroderma* Pers. (1801): Pers., more recent authors listed it as a probable synonym of *Calvatia* Hawksworth *et al.* 1995; Kirk *et al.* 2001). In the absence of any substantial evidence, however, the question remained: was *Omalycus* really a *Calvatia* or might it perhaps have been a *Scleroderma*? In the light of our conclusion that *Lycoperdon complanatum* Desf., and therefore also *Omalycus erosus*, is indeed a good *Calvatia*, and taking also into account the opinion of V. Demoulin (pers. comm.) that *O. violacinus* is the same species, it is our firm conviction that Rafinesque's *Omalycus* must be regarded as a synonym of *Calvatia*, confirming earlier suggestions to that effect and refuting its placement in the genus *Scleroderma*. The nomenclatural implication of this, however, is far-reaching.

*Omalycus* (1814) predates *Calvatia* Fr. (1849) by 35 years, and its adoption to cover species of *Calvatia* would require a considerable number of new combinations, something which is highly undesirable. Since *Calvatia* is already a *nomen conservandum*, it would be logical to add *Omalycus* to the list of rejected names against it, which would not preclude the use of *Omalycus* for a segregate including *C. cyathiformis*. A formal proposal to that effect has been submitted to the journal *Taxon*.

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## BORAGINACEAE

### CODONOIDEAE, A NEW SUBFAMILY BASED ON *CODON*

The genus *Codon* was formally established by Carl Linnaeus (1767) in the second volume of the 12th edition of his *Systema naturae*. He placed the genus in his Class X: Decandria, Monogynia. The generic name is derived from the Greek word *kodon*, a bell (although the flowers do not hang down), and alludes to the shape of the flowers of *C. royerii* L., which are deeply cup-shaped. *Codon* comprises two described species, *C. royerii* and *C. scheuchkii* Schinz, both endemic to Namibia and South Africa. A possible undescribed third species is found in the southern part of Namibia and is currently under investigation.

It was in France that a move towards more 'natural' groupings of plants was first made. It is clear from his writings that Linnaeus recognized natural affinities, but that ease of classification and identification were his main objectives (Gunn & Codd 1981). Michel Adanson's *Familles des plantes* (1763–64) can be regarded as the

first 'logically and philosophically sound basis for a classification of plants' (Stafleu & Cowan 1976). In 1789 Antoine-Laurent de Jussieu followed with his *Genera plantarum*. He published the description of 'Borragineae' as one of 100 orders (i.e. families). Many of his families are still maintained in modern classifications. De Jussieu based 'Borragineae' on the genus *Borago* L. He divided 28 genera into three different groups using fruit morphology as a distinguishing character: 1, berry-like fruits; 2, one- or two-locular capsules; and 3, four separate nutlets. He regarded *Codon* as a genus of uncertain position.

Of the five genera of Hydrophyllaceae known to him, De Jussieu (1789) assigned *Hydrophyllum* L., *Phacelia* Juss. and *Ellisia* L. to 'Borragineae' and *Nama* L. and *Hydrolea* L. to 'Convolvuli'. R. Brown separated the former trio of genera as the natural order Hydrophyllae in 1810, and the latter two as the natural order 'Hydroleae' in 1818. Choisy (1833) treated the Hydroleae in a mono-



graph, recognizing the genera *Hydrolea*, *Nama*, *Wigandia* Kunth and *Romanzoffia* Cham.; to these he added *Eriodictyon* Benth. in 1846, and at the same time vigorously defended the distinctness of the *Hydroleae*. De Candolle (1846: 589) was the first to place *Codon* in the family Hydrophyllaceae. Gray (1875) united all the genera mentioned in the family Hydrophyllaceae, which he divided into four tribes. Baillon (1890) merged Hydrophyllaceae under Boraginaceae, but his view was not followed at the time. Hydrophyllaceae was restored by Brand (1913) in a monograph of the family.

Until recently, most authors accepted the Hydrophyllaceae as a separate family. A comparison between Hydrophyllaceae and Boraginaceae in southern Africa based on pollen and macromorphological characters, however, shows a strong overlap of features. The surface structure of pyrenes of *Ehretia* P.Browne shows similarity with the seeds of *Nama* (compare Retief & Van Wyk 2001: 15 and Chance & Bacon 1984: 832), although this may not be meaningful, as the outer surfaces in these two structures are obviously not homologous. Of more significance is the likeness between pollen grains of *Wellstedtia* Balf.f. and those of *Eriodictyon*, *Nama* and *Phacelia* (compare Constance & Chuang 1982 and Retief & Van Wyk 2005); tapetal orbicules or Ubisch bodies—sporopollenin particles usually lining the inner tangential tapetal cell walls of secretory tapetums—of *Wellstedtia* and *Codon* show similarity in morphology (Retief *et al.* 2001). The broad family concept of Baillon (1890) is followed here, and we agree with the Angiosperm Phylogenetic Group (APG) (1998, 2003) and Långström & Chase (2002) who regard Hydrophyllaceae and Lennoaceae as synonyms of Boraginaceae *s.l.*

Modern views on the delimitation of Boraginaceae differ, for example, 1, segregating a separate family, Heliotropiaceae (Diane *et al.* 2002) from Boraginaceae *s.l.*; or 2, recognizing several segregate families: Boraginaceae *s. str.*, Cordiaceae, Ehretiaceae, Heliotropiaceae, Hydrophyllaceae, Lennoaceae and Wellstedtiaceae (Lebrun & Stork 1997; Gottschling *et al.* 2001; Gottschling 2003). However, in neither of these two approaches has the position of *Codon* been considered.

In Ferguson's (1999) phylogenetic analysis of evolutionary relationships within the Hydrophyllaceae, it is concluded that the family is nested within a paraphyletic Boraginaceae *s.l.*, excluding *Codon* and *Hydrolea*. *Hydrolea* is placed in a family of its own (APG II 2003). *Codon* is included in Boraginaceae *s.l.* in a treatment of this family for the Cape flora (Retief & Buys 2000: 374, 706). The genus *Codon* has traditionally been assigned to the Hydrophyllaceae, where it seems to be unusual geographically, as the family is otherwise largely restricted to the New World. Similarities between *Codon* and other members of Boraginaceae indicate that *Codon* should be placed in a subfamily of its own within Boraginaceae *s.l.* A new subfamily, Codonoideae, is established here to accommodate this southern African genus within Boraginaceae *s.l.*, the other local subfamilies being Wellstedioideae, Ehretioideae, Cordioideae, Heliotropioideae and Boraginoideae (Retief 2000: 179; Retief & Van Wyk 2001). The precise classification of the other, mainly New World genera (see Brand 1913) of Hydrophyllaceae *s. str.* within Boraginaceae *s.l.* has not yet been addressed

but they would most probably also require placement in one or more additional subfamilies.

Phytogeographically the restriction of *Codon* to the arid southwestern corner of Africa is of special interest. Its nearest relatives appear to be those members of Boraginaceae *s.l.* previously placed in Hydrophyllaceae *s. str.*, found mainly in North America, but with members of both *Nama* and *Phacelia* also occurring in South America (Deginani 1999). Among plants, African-New World distributions are rather unusual, but for southern Africa, involve as many as seven families and many more genera (Goldblatt 1978). It is intriguing that several other plant groups with a distribution pattern comparable to that of *Codon*, namely with a disjunct presence in southwestern and in northeastern Africa, show links with taxa in the New World. Among these are the boraginaceous genus *Wellstedtia* as well as members of *Calliandra*, *Caesalpinia*, *Haematoxylon*, *Hoffmannseggia*, *Parkinsonia*, *Xerocladia* (all Fabaceae), *Nicotiana* (Solanaceae), *Thamnosma* (Rutaceae) and *Turnera* (Turneraceae) (Van Wyk & Smith 2001). These African-New World disjuncts may have been established in different ways, but one possible explanation is based on the proximity of Africa and South America during Gondwana times and for quite some time after the break-up of the supercontinent.

Members of the new subfamily Codonoideae, established here, show the strongest affinity with the subfamilies Wellstedioideae and Ehretioideae in Boraginaceae *s.l.*—in similar pollen, inflorescence and trichome morphology. However, the Codonoideae differ from Wellstedioideae in the 10 or 12 (not 4) corolla lobes and in the seed which is subglobose and glabrous (not truncate and pubescent). They differ from Ehretioideae in habit in that they are annual or short-lived perennial herbs (not shrubs or trees) and in the fruit which is a capsule (not a drupe).

#### Codonoideae Retief & A.E.van Wyk, subfam. nov.

Type: *Codon royerii* L.

Herbae annuae vel breviter perennes, patentes ad erectae, interdum basi lignescentes. Partes vegetativae aculeato-pubescentes trichomatibus spiniformibus, et setis trichomatibusque multicellularibus non ramosis. *Folia* petiolata. *Flores* cymis scorpioides, ebracteati. *Calyx* profunde lobatus, lobi lineares. *Corolla* 10- vel 12-lobata, tubus cylindricus vel campanulatus, fauce glabra. *Stylus* terminalis, linearis, paene ad medium fissus, persistens; stigma capitatum. *Fructus* capsula multiseminalis. Semina globosa vel irregulariter angulosa, ornata.

Spreading to erect, annual or short-lived perennial herbs, sometimes woody at base. All vegetative parts prickly pubescent with spine-like trichomes, also with setae and unbranched, multicellular trichomes. *Leaves* petiolate. *Inflorescence* scorpioid. *Calyx* deeply lobed, lobes linear. *Corolla* 10- or 12-lobed, tube cylindric or campanulate, throat naked. *Style* terminal, linear, cleft to almost halfway, persistent; stigma capitate. *Fruit* a capsule, many-seeded. *Seeds* globose or irregularly angled, ornamented.

Genus: *Codon* L.

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## POACEAE

NOTES ON *ERAGROSTIS*A variant of *Eragrostis gummiflua* Nees?

*Eragrostis gummiflua* occurs in Botswana, Lesotho, Mozambique, Namibia, Swaziland, South Africa and Zimbabwe, usually on sand. Up to now, it has been one of the easier *Eragrostis* species to identify in these regions as it is a perennial with large, sticky, glandular patches below the collar on the leaf sheaths and often at the nodes as well. Sand grains or other pieces of material usually stick to these areas, making them easy to see. The nodes and area below the collar are often flushed purple, though sometimes the glandular patch below the collar is yellow or brown. The spikelet is purple to straw-coloured, with distinct, thick nerves on the lemmas. At maturity, the palea and lemma curve away from each other, leaving only their bases and apices touching and then resembling the pincers of a crab.

In December 1985 the author collected specimens in northeastern KwaZulu-Natal (2732 BA) that bore a close

resemblance to *E. gummiflua* but without any indication of sticky glandular patches. A further search in the PRE (National Herbarium, Pretoria) collection yielded two more specimens without these glandular patches, one from the Manzibomvu area (2732 DA) and another from southern Mozambique between Bela Vista and Umbeluzi (2632 ?). The main differences between these specimens and *E. gummiflua* are provided in Table 1.

To date, the non-sticky specimens seen by the author are from the biogeographical region known as Maputaland, an area that has been identified as an important centre of endemism and biodiversity in southern Africa (Siebert *et al.* 2004). It is bound by the Inkomati-Limpopo River in the north, the Indian Ocean in the east, the Lebombo Mountains in the west and by the St Lucia estuary in the south. Much of the area is a flat, low-level coastal plain with infertile soils consisting of geologically recent fine-grained aeolian sands. Climatically it lies within a transitional zone between

TABLE 1.—The main differences between *E. gummiflua sensu stricto* and the possible variant without the sticky glandular areas

Character	<i>E. gummiflua sensu stricto</i>	<i>E. gummiflua</i> variant?
Inflorescence	dense with the spikelets densely clustered on short secondary branches ( <i>Myre 1099*</i> )	more open and with fewer spikelets on the secondary branches
Spikelets	'untidy', as the florets appear slightly spirally arranged and overlapping	'neat' with florets clearly distichous
Leaf sheaths below collar	usually sticky, but sometimes not sticky and then clearly different in appearance ( <i>Ellis 5240**</i> )	often flushed purple but not sticky and with no indication of a different appearance in this area

\* The *Myre 1099* specimen had obviously been burnt and although sticky areas are present, the inflorescence is less dense tending towards that of the variant.  
\*\* *Ellis 5240* was originally thought to be the variant as it did not appear to be sticky, but closer examination showed differences in cell structure on the sheath just below the collar where the sticky glandular patches are usually found.

TABLE 2.—The main differences between *Eragrostis mexicana* subsp. *virescens* and *E. barrelieri*

Character	<i>E. mexicana</i> subsp. <i>virescens</i>	<i>E. barrelieri</i>
Inflorescence	copiously branched	moderately branched, with branches stiff
Inflorescence branches and/or pedicels	eglandular	crateriform glands
Spikelet	generally 1.0–1.2 mm wide but sometimes wider	generally wider than 1.5–1.8 mm
Lemma	1.3–1.7 mm long	1.7–2.3 mm long

tropical and subtropical coastal conditions where many tropical plants and animals reach the southern-most limit of their distribution range (Siebert *et al.* 2004).

Future study and more specimens are needed to decide whether the non-sticky form is a variant of *E. gummiflua* or a new taxon. The author would be happy to receive any duplicates of both forms from Maputaland and further north in Mozambique either on loan or as exchange material for PRE.

Specimens examined

*E. gummiflua* variant?

KWAZULU-NATAL.—2732 (Ubombo): 2 km S of Phelendaba, (–BA), along track, December 1985, *Smook 5716* (PRE); 2 km S of Phelendaba, December 1985, common around offices, deep sand, *Smook 5727*; Manzibomvu area, east of Mbazwane stream, (–DA), December 1971, open grassland, sandy soil, common, *Ward 7461* (PRE) (Siebert *et al.* 2004).

MOZAMBIQUE.—2632 (Bela Vista): between Bela Vista and Umbelusi, (–?AB), April 1949, *Myre 523* (PRE).

*E. gummiflua* s. str.

KWAZULU-NATAL.—2832 (Mtubatuba): northeast of Fanie's Island, (–AB), January 1960, in sandy soil, *Feely & Ward 25* (PRE).

MPUMALANGA.—2431 (Acornhoek): Arethusia Farm, Sabi Sands Game Reserve, (–CB), April 1987, damp sandy soil in seepage area, *Ellis 5240* (PRE), specimen without sticky erudite but indications of glandular area on leaf sheaths.

MOZAMBIQUE.—Gaza Dist., Banhina National Park (area covers part of 2232, 2233, 2322, 2323), October 1973, *Tinley 2979*; (possibly 2433CD), between Guija and Macia near side track to S. Paulo de Messano, June 1951, *Myre 1099*.

*Eragrostis mexicana* subsp. *virescens*, a new record for Botswana

The specimen *Hansen 3363* at PRE is here identified as *Eragrostis mexicana* (Hornem.) Link subsp. *virescens* (J.Presl.) S.D.Kock & Sánchez Vega (= *Eragrostis vires-*

*cens* J.Presl.). Previously the specimen at PRE was wrongly identified as *E. pilosa*, whereas in Cope (1999: 138) the duplicates of *Hansen 3363* housed at Kew and the National Herbarium of Zimbabwe are cited under *E. barrelieri*. In *E. pilosa* the palea falls at ± the same time as the lemma, whereas in *E. mexicana* subsp. *virescens* and *E. barrelieri* the palea persists long after the lemma has fallen. The two last-named taxa differ as given in Table 2 (Gibbs Russell *et al.* 1990; Cope 1999).

It is a new record of *Eragrostis mexicana* subsp. *virescens* for Botswana, therefore for the *Flora of southern Africa* (FSA) region, and it is the 115th *Eragrostis* species recorded for the *Flora zambesiaca* region.

Specimen examined

BOTSWANA.—2425 (Gaborone): Sebele Agriculture Research Station, (–DB), *Hansen 3363* (PRE).

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I wish to thank Tom Cope, Herbarium, Royal Botanic Gardens, Kew for always being willing to help and share his vast knowledge with me. Thanks to Emsie du Plessis and Gerrit Germishuizen for the editing and helping the text to flow smoothly and be understandable.

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## POACEAE

NAME USED IN THE FSA REGION FOR THE *CYMBOPOGON EXCAVATUS*–*CAESIUS*–*GIGANTEUS* COMPLEX

*Cymbopogon* Spreng. is notorious for being easily divided into complexes, but within the complexes the individual species are both variable and intergrading and are often based on rather ill-defined characters. *Cymbopogon excavatus* Stapf, *C. caesius* Stapf and *C. giganteus* Chiov. are the only species in the *Flora of southern Africa* (FSA) region belonging to a complex easily recognizable by the lowermost internode and pedicel of the raceme that are swollen and fused. An additional character often used, but not always easy to see, is the V-shaped median groove on the lower glume of the sessile spikelet.

*Cymbopogon caesius* and *C. excavatus* have been separated from each other by characters such as width of the wings of the lower glume of the sessile spikelet, shape of the leaf base and the stronger tussock growth form of *C. excavatus* (Soenarko 1977; Clayton & Renvoize 1982). *C. giganteus* was separated from the two species mentioned above by its broader leaves (Clayton & Renvoize 1982). Clayton & Renvoize (1982) placed *C. excavatus* in synonymy under *C. caesius*, keeping *C. giganteus* a separate species. Sales (2002) kept *C. excavatus* as a synonym of *C. caesius* but reduced *C. giganteus* to a subspecies of *C. caesius*. In the FSA region the name *C. excavatus* was used for both the narrow- and much broader-leaved specimens (Chippindall 1956; Gibbs Russell *et al.* 1990). Sales (2002) records both subsp. *caesius* and subsp. *giganteus* for Botswana. It therefore seemed appropriate to re-examine all specimens from the FSA region at PRE.

Working through the collection at PRE and using all the available literature, a number of problems become apparent. Accepting *C. excavatus* as a synonym of *C. caesius*, the main characters used in the past to separate *C. caesius* and *C. giganteus* are:

Leaf blades up to 8 (rarely 10) mm wide, ligule 1–4(–5) mm long; culms wiry or slender ..... *C. caesius*  
 Leaf blades over 8 mm wide (e.g. Clayton & Renvoize 1982) or (9–)10–22 mm wide, ligule rarely longer than 1 mm; culms robust ..... *C. giganteus*

There is no definition of precisely what is meant by 'wiry', 'slender' and 'robust' nor any agreement on the cut-off points of the leaf width. The width of the leaf blade on herbarium specimens may not be representative of the plant, as Sales (2002) notes 'Lamina width can vary greatly in an individual and measurements should be taken of the widest leaves in a specimen'. In Sales (2002) the specimen *Skarpe* 287 from Botswana housed

at Kew (K) is cited as subsp. *giganteus*, which according to the key has 'leaves (9–)10–22 mm wide' but in the duplicate of *Skarpe* 287 at PRE the leaves are no wider than 7 mm.

The ligule length of the specimens at PRE also does not correlate with the above-mentioned characters. There are, for example, specimens with leaf blades 9–10 mm wide, ligules 3–5 mm long and culms varying from robust through moderately robust to slender.

Distribution also does not separate the two taxa: although specimens with, say, the broadest leaves may be more common in one area than in another, both forms occur right across the FSA region.

Therefore, until further studies are done in the field or better characters are found to separate *C. caesius* from *C. giganteus*, at PRE I shall treat all specimens of which the lowermost internode and pedicel of the raceme are swollen and connate, as *C. caesius*.

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## HYACINTHACEAE

*ORNITHOGALUM JUNCIFOLIUM* VAR. *EMSII*, A NEW CLIFF-DWELLING *ORNITHOGALUM* FROM EASTERN CAPE, SOUTH AFRICA

## INTRODUCTION

The bulbous genus *Ornithogalum* L. consists of 200 species of which  $\pm 108$  are confined to South Africa and

particularly to the Cape Floristic Region (Obermeyer 1973; Manning & Goldblatt 2003). Recent field studies on cliffs associated with dry river valleys revealed several plant taxa new to science (Van Jaarsveld & Van Wyk



FIGURE 8.—*Ornithogalum juncifolium* var. *emsii*,  $\times 1$ , showing basal vegetative bulbils. Artist: Lisa Strachan.

1999, 2003; Van Jaarsveld 2003). Among these, a new variety of *Ornithogalum juncifolium* was collected and is described in the present paper.

Whereas many bulbous plants grow opportunistically on cliffs, *O. juncifolium* var. *emsii* is encountered only in this type of habitat and appears to be an obligate cremno-phyte (*cremno* is derived from the Greek for cliff and *phyton* means plant). Owing to the vertical orientation of cliffs, water run-off is extreme, resulting in a mostly very dry habitat with succulents often a conspicuous feature on precipices in South Africa.

***Ornithogalum juncifolium* Jacq. var. *emsii* Van Jaarsv. & A.E. van Wyk., var. nov., a var. typica tepalis 10–12 mm longis, bulbillis e basi dense proliferantibus et florescentia medio aestate (mense Decembri) differt.**

**TYPE.**—Eastern Cape, 3326 (Grahamstown): cliffs overlooking the Koonap River, near the Koonap Reserve, (–BA), 08-10-2002, Van Jaarsveld & Ems 16808 (NBG, holo.).

Plants bulbous, epigeous and forming round clusters up to 100 mm diam. and consisting of many bulbs and bulbils. *Bulbs* globose, 15–20 mm diam. and high; tunics grey, papery and exposing green live tissue; basal part of bulb continuously proliferating, forming many ovate to rounded bulbils, up to 5 mm in diam.. *Leaves* 2 or 3, synantherous, linear, half-terete, 95–150  $\times$  1.5 mm, apex acute, dark green; adaxial surface shallowly canaliculate; abaxial surface rounded; base sheathing, tubular with short membranous neck, 5–8  $\times$  2–3 mm; margin minutely ciliate. *Raceme* 100–200 mm long, 8–12-flowered; scape terete, erect; bracts deltoid-cuspidate, auriculate, up to 6  $\times$  2 mm; pedicel up to 4–5 mm long, lengthening up to 6–7 mm in fruit. *Perianth* stellate, white, up to 20–24 mm diam. *Tepals* linear-lanceolate, 3 inner 10–12  $\times$  3.0–3.5 mm, white with green median stripe. *Stamens* 5 mm long; outer filaments flattened, linear-acuminate, 1 mm diam. at base; inner filaments shorter, ovate-triangular, up to 1.5 mm long; anthers 0.8 mm long, yellow. *Ovary* ovate, 3  $\times$  2 mm, green, shortly stipitate; style erect, 4 mm long; stigma capitate. *Capsule* ovoid, 5–7  $\times$  3–4 mm. *Seeds* triangular-ovate, 1.5  $\times$  0.8 mm, black, denticulate, 24 per capsule. Figure 8.

**Phenology:** flowering mainly from early December to January (summer). Seeds are dispersed by wind in summer and early autumn (October onwards).

**Diagnostic features and affinities:** *Ornithogalum juncifolium* var. *emsii* is at once distinguished from the typical variety by its proliferous production of bulbils at the base of the bulb and its flowering time which is from December to January. Var. *juncifolium* flowers from spring to early summer and has slightly smaller flowers (tepals 7–10 mm long) and does not have the dense basal proliferation of small bulbils.

**Distribution, habitat and cultivation:** *Ornithogalum juncifolium* var. *emsii* is known only from vertical south-facing shale cliffs of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup, overlooking the Great Fish

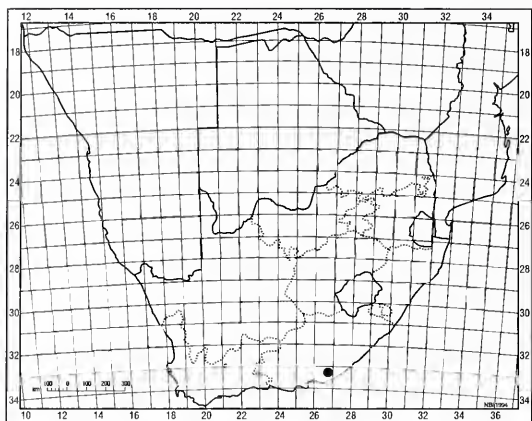


FIGURE 9.—Known distribution of *O. juncifolium* var. *emsii*, ●.

River (Figure 9). It grows sympatrically with *O. bolusia-num* and is also an Albany Centre endemic (Van Wyk & Smith 2001). On the other hand, var. *juncifolius* is widely distributed, ranging from the Western Cape northwards on or below the Great Escarpment to Gauteng and North-West.

Plants of var. *emsii* are locally common, consisting of small epigeous, globose clusters of green (photosynthetically active, though covered with dry, grey tunics) and two or three spreading, pendent, filiform leaves, an adaptation to shady cliffs. The prolific formation of basal bulbils results in a continuous release of vegetative propagules, enabling the plant to establish in adjacent rock crevices. It is often mat-forming and plants may completely fill a single crevice. This vegetative reproductive strategy has also been observed in other cliff-dwelling bulbous species such as *Cyrtanthus montanus*, *C. labiatus*, *C. inaequalis* and *Ornithogalum longibracteatum* (Van Jaarsveld & Van Wyk 2003).

The very thin, wiry leaves of *O. juncifolium* var. *emsii* are evergreen and bundled together at the base, allowing for maximum light penetration while also contributing to photosynthesis. The spreading leaves sometimes become pendent with age. The bulbils are also enveloped in grey tunics which probably serve to block excessive light and

to reduce transpiration. Plants are long-lived with the dry leaves persistent, withering from the base. The black, angled, light seeds are shaken from the capsules and are wind-dispersed in summer.

Plants are easily grown by bulbils and thrive in cultivation.

**Etymology:** the specific epithet *emsii* is named after Paul Ems, horticulturist and botany student who first spotted the plants, in recognition of his assistance in the field.

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## RUBIACEAE

### INFRASPECIFIC TAXA IN A SOUTHERN AFRICAN *PAVETTA* SPECIES

The genus *Pavetta* L. comprises ± 400 species occurring in the Old World tropics (Bridson 2003) with 21 species in the summer rainfall areas of southern Africa (Retief & Leistner 2000). In 1929 Bremekamp revised the South African species of the genus *Pavetta*, followed by a monograph of the group in 1934. Several authors, e.g. Bridson (1978) and Kok & Grobbelaar (1984), maintained that Bremekamp not only recognized too many species but that some of the species delimitations were unsatisfactory. Subsequently several of his species were placed in synonymy by Bridson (1978) and Kok &

Grobbelaar (1984). Although these later treatments did help to make identifications easier, some taxa seem to be 'waste bins' in which too many names were dumped, e.g. *Pavetta zeyheri* Sond. Kok & Grobbelaar (1984) listed 10 names as synonyms under *P. zeyheri* including *P. microlancea* K.Schum., *P. middelburgensis* Bremek. and *P. lasiopeplus* K.Schum. Recently Bridson (2003) resurrected *P. lasiopeplus* and hinted that *P. microlancea* and *P. middelburgensis* may deserve recognition as distinct taxa. It seems that Coates Palgrave (2002) also upheld *P. lasiopeplus* as separate from *P. zeyheri*.



TABLE 1.—Comparison between the three subspecies of *Pavetta zeyheri*

	subsp. <i>zeyheri</i>	subsp. <i>middelburgensis</i>	subsp. <i>microlancea</i>
Life form	Shrub or small tree	Dwarf shrub	Shrub
Plant height (m)	(0.5)1–4	Up to 0.5	0.3–0.8(–1.0)
Leaf			
length (mm)	(20.5)28.0–57.0(68.0)	17–36	(17.0)23.5–31.0(40.0)
width (mm)	(4.5)5.0–12.0(15.5)	2.5–6.0	3.0–5.5(7.0)
shape	Narrowly obovate oblanceolate, narrowly elliptic	Narrowly obovate (oblanceolate)	Narrowly obovate/oblanceolate to narrowly elliptic
apex	Acute, rounded to obtuse	Acute	Acute
base	Cuneate, sessile	Cuneate, sessile	Cuneate, sessile
Domatia	Absent	Absent	Absent
Inflorescence branches	Apparent	Apparent	Suppressed
Calyx			
*tube length (mm)	1.2–2.0	1.0–1.5	1.5–2.0
lobe length (mm)	0.5–2.0	0.5–1.2	1–2
Corolla			
tube length (mm)	7–14	7–14	6–10
lobe length (mm)	6.0–9.5	6–9	5.0–7.5
lobe width (mm)	2–3	2–3	1.5–2.5
Style length (mm)	18–33	(17)21–29	(14)21–23
Anther length (mm)	5.5–9.0	4.5–7.0	4–6
Fruit diam. (mm)	6–10	5–6	5–6
Habitat	Rocky outcrops, hillsides, also on flats, on sandy soil.	Amongst outcrops of rocks and boulders, rocky sheets	Rocky slopes, loamy flats
Distribution	B, LIM, NW, G, M, FS.	M	M; probably extending into adjacent parts of Mozambique

B, Botswana; LIM, Limpopo; NW, North-West; G, Gauteng; M, Mpumalanga; FS, Free State.

\* Calyx tube = ‘hypanthium’ + limb-tube.

Bremekamp (1934) separated *P. zeyheri* from *P. middelburgensis* and *P. microlancea* on the grounds of the leaf shape and ratio of leaf length to width. He distinguished between *P. middelburgensis* and *P. microlancea* on the grounds of corolla and leaf length. The leaves of *P. microlancea* and *P. middelburgensis* are usually very small, but a study of material housed in PRE and PRU showed no clear discontinuity in size among the three taxa discussed in the present contribution (Table 1) and these differences are not reliable for distinguishing the three taxa. In all three species the corolla tube is hairy inside.

As the differences in leaf shape and size, and the morphology of the flowers show some integration, it is difficult to justify three separate species. However, because of the differences in growth form and the disjunct geographical distribution, *P. middelburgensis* and *P. microlancea* are formally reinstated as subspecies of *P. zeyheri* in the present contribution. *P. lasioeplus* K.Schum. is upheld, following Bridson (2003). Bridson (2003) distinguishes between *P. zeyheri* and *P. lasioeplus inter alia* on the grounds of the differences in the length of the calyx lobes: 0.5–1.5(–2.0) mm in *P. zeyheri* and 2–3 mm in *P. lasioeplus* and inflorescence branches apparent in *P. zeyheri*, but suppressed in *P. lasioeplus*. These were the only reliable characters found to distinguish between these two species in material studied at PRE. Silky hairs on the inflorescence bracts were observed in almost all the *P. zeyheri* specimens examined at PRE, yet Bridson (2003) maintained they are without silky hairs. The shape of the stipules varies too much to be used as a distinguishing character between these two species.

*P. dissimilis* Bremek., *P. pseudozeyheri* Bremek., *P. zeyheri* Sond. var. *brevituba* Bremek., *P. zeyheri* Sond. var. *pubescens* Bremek. and *P. zeyheri* Sond. var. *sonderi* Bremek. are all regarded as part of *P. zeyheri* subsp.

*zeyheri*, as the differences given by Bremekamp (1929, 1934) are only part of the variation range of this taxon.

***Pavetta zeyheri* Sond.**, *Flora capensis* 3: 21 (1865); Bremek.: 211 (1929); Bremek.: 183 (1934); Launert: 23 (1966); Kok & Grobbelaar: 187 (1984); Retief & P.P.J.Herman: 588 (1997); Coates Palgrave: 1123, 1124 (2002); Bridson: 582, 583 (2003); Retief: 837 (2003). Type: Transvaal [Gauteng], Vaal River, *Burke s.n.* (K, PRE, –photo.!; Sl, TCD, –photo.!).

subsp. ***zeyheri sens. str.***

*Ixora zeyheri* (Sond.) Kuntze: 287 (1891).

*P. dissimilis* Bremek.: 211 (1929); Bremek.: 183 (1934). Type: Middleberg, *Gray 4188* (PRE!).

*P. pseudozeyheri* Bremek.: 211 (1929); Bremek.: 183 (1934). Type: Transvaal [North-West], Rustenburg, *Bremekamp 103* (PRE!).

*P. zeyheri* Sond. var. *brevituba* Bremek.: 212 (1929); Bremek.: 184 (1934). Type: Transvaal [Gauteng], Pretoria District, *Nelson s.n. Transv. Mus.11710* (PRE!).

*P. zeyheri* Sond. var. *pubescens* Bremek.: 212 (1929); Bremek.: 184 (1934). Type: Transvaal [Gauteng], Pretoria, Premier Mine, *Pollak s.n. PRE41394* (PRE!).

*P. zeyheri* Sond. var. *sonderi* Bremek.: 184 (1934). Type: Transvaal [Gauteng], Pretoria, Magalisberg [Magaliesberg], *Zeyher 768* (Sl, PRE, photo.!).

*P. zeyheri* subsp. *zeyheri* is a shrub or small tree, usually single-stemmed, 1–4 m tall. *Leaves* narrowly obovate, oblanceolate to narrowly elliptic, (20.5)28.0–57.0 (68.0) × (4.5)5.0–12.0(15.5) mm. *Inflorescence branches* apparent; bracts with silky hairs on inside; calyx lobes 0.5–2.0 mm long. Grows mainly on rocky outcrops and

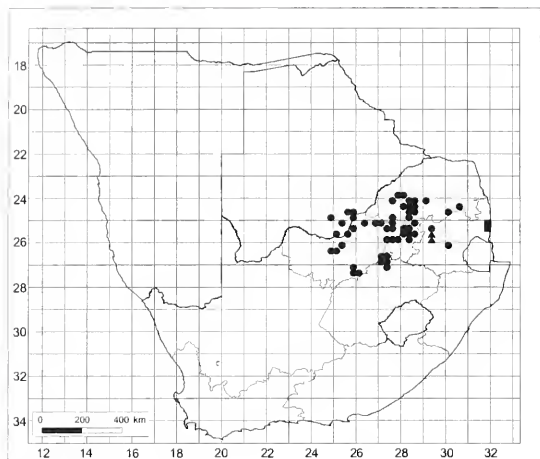


FIGURE 10.—Distribution of *P. zeyheri* subsp. *zeyheri*, ●; *P. zeyheri* subsp. *middelburgensis*, ▲; and *P. zeyheri* subsp. *microlancea*, ■, in southern Africa.

hillsides, but also on flats, often on sandy soil in Botswana, Limpopo, North-West, Gauteng, Mpumalanga and the Free State (Figure 10).

**BOTSWANA.**—2425 (Gaborone): Mmokolodi, 12 km S of Gaborone, (–DB), *Cole* 642 (PRE); Mokolodi Village, Mokolodi Reserve, 15 km S of Gaborone, (–DD), *Cole* 1154 (PRE).

**LIMPOPO.**—2427 (Thabazimbi): Waterberg Dist., Vaalwater, Farm Malmanies River, (–BA), *Hardy, Retief & Herman* 5301 (PRE, PRU). 2428 (Nylstroom): Waterberg Dist., 3 km W of Nylstroom–Vaalwater road, on road to Loubad, (–CB), *Reid* 460 (PRE).

**NORTH-WEST.**—2525 (Mafikeng): Botsalano Game Reserve, (–DA), *Phalatsé* 170 (PRE). 2527 (Rustenburg): 3 miles (4.8 km) S of Rustenburg on road to Rustenburg Kloof, (–BA), *De Winter* 7800 (PRE). 2625 (Delareyville): E of Madibogo, Madibogo Hills, (–AC), *Gubb* KMG10737 (PRE). 2627 (Potchefstroom): Dassiesrant, (–CA), *Botha & Ubbiuk* 1819 (PRE). 2725 (Bloemhof): Leeuwfontein, 10 km W of Wolmaranstad, (–BB), *A.E. van Wyk* 758 (PRE).

**GAUTENG.**—2527 (Rustenburg): Hartbeestpoort Dam, Dr Brassy's Farm, (–DD), *Mogg* 34052 (PRE). 2528 (Pretoria): Fountains Valley, (–CA), *Repton* 98 (PRE); Lukasrand, below Post Office Tower,

(–CD), *Retief & Herman* 171 (PRE, PRU).

**MPUMALANGA.**—2529 (Witbank): Loskopdam Nature Reserve, (–AD), *Theron* 1094 (PRE, PRU). 2630 (Carolina): Carolina, (–AA), *Nicholson* PRE4312 (PRE).

**FREE STATE.**—2727 (Kroonstad): Vredefort Dist., (–AB), *Oliver* 277 (PRE).

subsp. ***middelburgensis*** (*Bremek.*) *P.P.J.Herman*, comb. et stat. nov.

*P. middelburgensis* Bremek. in *Annals of the Transvaal Museum* 13: 212 (1929); Bremek.: 184 (1934). Type: Mpumalanga, Middelburg, without exact locality, *Jenkins s.n. Transv. Mus.* 9828 (PRE, holo.!).

*Pavetta zeyheri* subsp. *middelburgensis* is a dwarf, compact shrub, almost bonsai-like, up to 0.5 m tall, growing wedged amongst outcrops of rocks and boulders or rocky sheets, confined to Middelburg area, Mpumalanga (Figures 10, 11). *Leaves* small, narrowly obovate or oblanceolate, 17–36 × 2.5–6.0 mm. *Inflorescence* branches apparent; bracts with silky hairs on inside; calyx lobes 0.5–1.2 mm long.

**MPUMALANGA.**—2529 (Witbank): Doornkop 273 J.S., 'Ghost Rocks' W of Eerstekamp, (–CB), *Du Plessis* 984 (PRE, PRU); Botsabelo, (–CD), *Codd & Dyer* 2869, *Fouche s.n. Transv. Mus.* 26971, *Herman* 1531, 1532 (PRE), *Schlechter* 3781 (PRE, PRU); kopie W of Middelburg, (–CD), *Brusse* 1932 (PRE); Witbank Nature Reserve, (–CD), *Smit* 1843 (PRU); Middelburg, without exact locality, *Thode* A1610 (PRE).

subsp. ***microlancea*** (*K.Schum.*) *P.P.J.Herman*, comb. et stat. nov.

*P. microlancea* K.Schum. in *Botanische Jahrbücher* 28: 80 (1899), Bremek.: 212 (1929); Bremek.: 184 (1934). Type: Mpumalanga, Komatipoort, without exact locality, *Schlechter* 11760 (B, holo.–PRE!).

*Pavetta zeyheri* subsp. *microlancea* is a small shrub, 0.3–0.8(–1.0) m tall, growing on rocky slopes or loamy flats in the Sabie, Komatipoort and Crocodile Bridge areas of Mpumalanga (Figure 10). *Leaves* vary from narrowly obovate or oblanceolate to narrowly elliptic, (17.0)



FIGURE 11.—Habit and habitat of *Pavetta zeyheri* subsp. *middelburgensis*.

23.5–31.0(–40.0) × 3.0–5.5(–7.0) mm. *Inflorescence* branches suppressed; bracts with silky hairs on inside; inflorescence few-flowered (mostly 4–6); calyx lobes 1–2 mm long.

Coates Palgrave (2002) referred to a large-leaved form of *P. zeyheri* which grows up to 3 m tall in the Sekhukhuland area as probably *P. microlancea*, but it cannot be the same taxon as described above because of the differences in stature of the plants. The so-called Sekhukhuland form of *P. zeyheri* is characterized by blue-green leaves and may well represent a separate species—it is listed as *Pavetta* sp. nov. (tree number 722.1) in Von Breitenbach *et al.* (2001). Bridson (2003) mentioned that *P. microlancea* differed from *P. zeyheri* sens. str., apart from size, in having fewer-flowered, umbellate inflorescences subtended by bracts with silky hairs.

MPUMALANGA.—2531 (Komatiport): Kruger National Park, 10 miles S of Lower Sabie camp, (–BB), *Codd 6133* (PRE, KNP); Kruger National Park, Lower Sabie/Crocodile River Bridge, near Nthandanyathi waterhole, *Van Rooyen 4133* (PRU); between Komatiport and Letaba River, on the Selati railway, (–BD), *Rogers 12887* (PRE); 3 miles (4.8 km) N of Crocodile River Bridge, Kruger National Park, (–BD), *P. van Wyk 4735* (PRE, KNP).

#### CONSERVATION STATUS

Given the very restricted geographical distribution of both *P. zeyheri* subsp. *middelburgensis* and subsp. *microlancea*, these two taxa should probably be declared Vulnerable, the population restricted to an area of occupancy < 100 km<sup>2</sup> (VU D2) according to the 1994 IUCN Red List categories (Golding 2002).

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## AGAPANTHACEAE

### SYNONYMY IN AGAPANTHUS

#### INTRODUCTION

The sole member of the family Agapanthaceae, *Agapanthus* L'Hér. is endemic to four southern African countries, Lesotho, Mozambique, South Africa and Swaziland (Duncan 2003). Represented by *A. africanus* in the southwestern Cape, the genus is distributed from the Cape Peninsula eastwards to the southern, southeastern, eastern and northern parts of the subcontinent, terminating in the Soutpansberg Mountains south of the Limpopo River in Limpopo (Leighton 1965). *Agapanthus* has always presented a special problem in classification due to the extreme morphological variability within the species and the paucity of reliable characters on which to base them. The genus was last revised by

Leighton (1965) whose morphological and geographical study resulted in the recognition of ten species, in which she made the following statement: 'I have explored every avenue for characters on which to base the species of *Agapanthus* and have found very few which are reasonably constant'.

The modern multidisciplinary approach to classification has resulted in more avenues becoming available for delimitating species boundaries. Recent research using somatic nuclear DNA content, as measured in picograms (pg) using flow cytometry with propidium iodide, as well as pollen colour and vitality, introduced novel criteria in effectively delimitating the species of *Agapanthus* (Zonneveld & Duncan 2003). Based on these criteria, as



well as morphological and distribution data, it was proposed that the number of species be reduced to six, namely *A. africanus* (L.) Hoffmanns., *A. campanulatus* F.M.Leight., *A. caulescens* Sprenger, *A. coddii* F.M.Leight., *A. inapertus* P.Beauv. and *A. praecox* Willd., with the recognition of a high degree of variation within each species. The DNA content confirmed several relationships previously speculated by Leighton (1965), and combined with pollen colour, the species were effectively divided into two distinct groups: a group with lilac pollen and a DNA content of 22.3–24.0 pg containing the species *A. campanulatus*, *A. caulescens* and *A. coddii*, and a group with yellowish brown pollen and a DNA content of 25.2–31.6 pg containing the species *A. africanus*, *A. inapertus* and *A. praecox*. The narrow endemic *A. walshii* L.Bolus from the southwestern Cape was most appropriately treated as a subspecies of the more widespread *A. africanus* as *A. africanus* subsp. *walshii* (L.Bolus) Zonn. & G.D.Duncan, *A. comptonii* F.M.Leight. was found to be synonymous with *A. praecox* subsp. *minimus* (Ker Gawl.) F.M.Leight., *A. nutans* F.M.Leight. was found to be synonymous with *A. caulescens* subsp. *gracilis* F.M.Leight., and *A. dyeri* F.M.Leight. was found to be synonymous with *A. inapertus* subsp. *intermedius* F.M.Leight. The new combination *A. africanus* subsp. *walshii* has already been formalized (Zonneveld & Duncan 2003), and discussed in more detail (Duncan 2004). The opportunity is taken here to formalize the synonymy of *A. comptonii*, *A. dyeri* and *A. nutans*, as follows:

#### NEW SYNONYMY

***Agapanthus praecox* Willd. subsp. *minimus* (Ker Gawl.) F.M.Leight.** in Journal of South African Botany, Suppl. vol. 4: 22 (1965). Type: without locality and collector [Botanical Register 9: t. 699 (1823), lecto., here designated].

*A. comptonii* F.M.Leight. subsp. *comptonii*: 24, 27 (1965), syn. nov. Type: Eastern Cape, Bathurst: Kaffir Drift, *Compton s.n.* NBG397/45 (BOL, holo.; NBG, iso.).

*A. comptonii* F.M.Leight. subsp. *longitubus* F.M.Leight.: 27, 29 (1965), syn. nov. Type: Eastern Cape, East London: Chalumna Causeway, *Smith s.n.* NBG135/45 (BOL, holo.; NBG, iso.).

*Agapanthus praecox* is an evergreen, extremely variable species with regard to perianth size and shape, and overall plant size and habit, and has a fairly wide distribution extending from Knysna in the southern Cape to Port Shepstone on the KwaZulu-Natal south coast. Leighton (1965) recognized three subspecies: subsp. *praecox*, subsp. *minimus* and subsp. *orientalis*. The subspecies *minimus* is distinguished from the other subspecies by the relatively small overall plant size, the plants do not form dense clumps, they have fewer-flowered inflorescences and a slender peduncle usually less than 600 mm high. The dwarf species *A. comptonii* occurs in Eastern Cape from Bathurst to East London, and comprises subsp. *comptonii* and subsp. *longitubus*. The subsp. *comptonii* is distinguished from subsp. *longitubus* by its perianth tube being one third or less of the perianth length, versus more than one third or nearly half the perianth length in subsp. *longitubus*. There is no convincing way of distinguishing subsp. *comptonii* and

subsp. *longitubus* morphologically from *A. praecox* subsp. *minimus*, which has similar evergreen leaves and overall plant size, and shows a gradation in perianth tube length that includes those of subsp. *comptonii* and subsp. *longitubus*. The distribution ranges of subsp. *comptonii* and subsp. *longitubus* fall within that of *A. praecox* subsp. *minimus*, and both subsp. *comptonii* and *A. praecox* subsp. *minimus* occur in the Bathurst area (Leighton 1965). The nuclear DNA content of subsp. *comptonii* and subsp. *longitubus* ranges from 25.40–25.61 pg which is within the range for *A. praecox* subsp. *minimus*, and they are therefore considered synonymous with *A. praecox* subsp. *minimus* (Zonneveld & Duncan 2003). *A. praecox* subsp. *orientalis* remains valid and is recognized by its dense clumps producing relatively broad, arching foliage, its sturdy peduncles well over 600 mm, and its large, dense inflorescences.

***Agapanthus caulescens* Sprenger subsp. *gracilis* F.M.Leight.** in Journal of South African Botany, Suppl. vol. 4: 36 (1965). Type: KwaZulu-Natal, Ubombo-Ingwavuma range, *Gerstner 3189* (BOL, holo.; NBG, iso.).

*A. nutans* F.M.Leight.: 38 (1965), syn. nov. Type: KwaZulu-Natal, Estcourt: Mooi River, *Cheape s.n.* NBG824/53 (BOL, holo.; NBG, iso.).

*Agapanthus caulescens* is a deciduous, summer-growing species found in KwaZulu-Natal, Mpumalanga and Swaziland. Leighton (1965) recognized three subspecies: subsp. *caulescens*, subsp. *angustifolius* and subsp. *gracilis*. Subspecies *gracilis* is distinguished by its more slender, laxer growth form and its smaller flowers with the perianth segments recurving markedly towards the apices. *A. nutans* and *A. caulescens* subsp. *gracilis* both have similar distinctly caulescent shoots, and linear, deciduous leaves with hyaline margins. The degree of recurving of perianth segments does not seem an important difference, as those of *A. nutans* also show some degree of recurving. Leighton (1965) also regarded *A. nutans* as distinct due to its nodding flowers, but both nodding and spreading flowers may occur within the same inflorescence and does not seem an important difference. *A. nutans* only occurs as single plants, not in populations; Leighton (1965) said of *A. nutans*: 'I am aware that the sporadic occurrence of all those plants I have placed in *A. nutans* may very well mean that they are all mutants which arise from time to time, and I regard this as a grouping of like forms rather than a close-knit species'. *A. nutans* occurs within the distribution range of *A. caulescens* and Leighton (1965) stated that *A. nutans* has links with *A. caulescens* subsp. *gracilis*. Both *A. nutans* and *A. caulescens* subsp. *gracilis* are recorded from Ingwavuma in the Ubombo Mountains of KwaZulu-Natal. The nuclear DNA content of *A. nutans* was found to be 23.38 pg which is within the range for *A. caulescens*, and it is therefore considered synonymous with *A. caulescens* (Zonneveld & Duncan 2003), most appropriately placed under *A. caulescens* subsp. *gracilis*.

***Agapanthus inapertus* P.Beauv. subsp. *intermedius* F.M.Leight.** in Journal of South African Botany, Suppl. vol. 4: 45 (1965). Type: Mpumalanga, Standerton: near Palmford, *Reynolds 7214* (BOL, holo.; NBG, iso.).

*A. dyeri* F.M.Leight.: 46 (1965), syn. nov. Type: Limpopo, Polokwane [Pietersburg]: Blaauberg, Mhlakeng Plateau, Dyer & Codd 8765 (PRE, holo.).

*Agapanthus inapertus* is a deciduous, summer-growing species, widely distributed in Mpumalanga and Limpopo, and also occurring in Gauteng and Swaziland. Leighton (1965) recognized five subspecies: subsp. *inapertus*, subsp. *hollandii*, subsp. *intermedius*, subsp. *parviflorus* and subsp. *pendulus*. Subspecies *intermedius* has flowers 25–45 mm long and the perianth segments range from those which spread very little to forms in which they spread appreciably (Leighton 1965). Its distribution covers the whole territory of the species, occurring mostly on the fringes (Leighton 1965). *A. dyeri* is recorded from two widely separated localities, Mhlakeng on the Blouberg Plateau near Polokwane (Pietersburg) in Limpopo, and at Namaachas in southwestern Mozambique (Leighton 1965; Duncan 1993). Leighton (1965) said of *A. dyeri*: 'This species is very close to *A. inapertus* subsp. *intermedius*, but the very short tube precludes it from being placed in that species'. Tube length in *A. dyeri* does not seem an important difference as it shows a gradation of sizes to those of *A. inapertus* subsp. *intermedius*, and geographically, *A. dyeri* occurs within the same area of distribution as *A. inapertus* subsp. *intermedius*, such as on the Blouberg Plateau (Leighton 1965). Dr R.A. Dyer, after whom *A. dyeri* was named in 1965, himself questioned the validity of this species, as follows: 'I am not so modest that I should wish to see *A. dyeri* Leighton relegated to synonymy, but I foresee the day when some worker will wish to know more precisely what its relationship

is to *A. inapertus* subsp. *intermedius*, which is also recorded from the Blouberg Plateau, the type locality for *A. dyeri*' (Dyer 1966). The nuclear DNA content of *A. dyeri* was found to range from 24.99–25.17 pg (including the geographically isolated plants from Namaachas in southwestern Mozambique), which is within the range of *A. inapertus* subsp. *intermedius*, and it is therefore considered synonymous with *A. inapertus* subsp. *intermedius* (Zonneveld & Duncan 2003).

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## OROBANCHACEAE

### A NEW SPECIES OF *HARVEYA* FROM WESTERN CAPE, SOUTH AFRICA

The hemi- or holoparasitic genera of Scrophulariaceae *sensu lato*, in which the upper lip of the corolla is fully or partially enclosed by the lower in bud, are now recognized to comprise the family Orobanchaceae (Angiosperm Phylogeny Group 1998). Among the four holoparasitic genera of Orobanchaceae that are regarded as native in southern Africa, the genus *Harveya* Hook. is distinguished by its large, brightly coloured and often attractive flowers with a 5-lobed,  $\pm$  bilabiate corolla. The well-developed corolla tube is straight or slightly curved and the anthers, with one exception, are 2-theous with one theca reduced in size and sterile. Currently 40 species of *Harveya* are recognized from Africa and the Mascarenes (Smithies 2000), with  $\pm$  25 species from southern Africa, but the genus is urgently in need of revision. The South African species were last treated by Hiern (1904), who recognized 21 species from the sub-continent, 14 of them from the Cape Floral Region. The description of three additional species from KwaZulu-Natal by Hilliard & Burt (1986) increased the number to the current total. It was evident to Goldblatt & Manning (2000), however, that several of the species from the Cape Floral Region were of dubious status. In their account of the genus they admitted just nine species from the region. This treatment has recently been supported by Randle (2004).

Among the undetermined collections at the Compton Herbarium was a specimen from the Little Karoo, determined as *H. hyobanchoides* Schltr. ex Hiern, but the accompanying colour notes indicated the anomalous colour combination of white flowers among red floral bracts. A recent colour photograph from a second population of plants sent to the herbarium alerted us to the likelihood that this taxon represented an undescribed species and an expedition was mounted to the original locality to collect fresh material. This confirmed that the plant was distinct and we name it *Harveya roseoalba*.

***Harveya roseoalba* J.C.Manning & Goldblatt, sp. nov.**

TYPE.—Western Cape, 3321 (Ladismith): Gamkaberg Nature Reserve, (–BD), stony slopes at 910 m, 24 September 2004, P. Goldblatt & J.H.J. Vlok 12547 (NBG, holo.; E, K, MO, PRE, iso.).

Plantae holoparasiticae 100–180 mm altae, partibus omnibus, praeter corollam, roseis ad carmineis, dense viscido-villosis vel lanatis, inflorescentia spica congesta vel racemus spiciformis, bracteis obovato-rhomboides 15–25  $\times$  10–15 mm, adaxialiter glabris, calyce

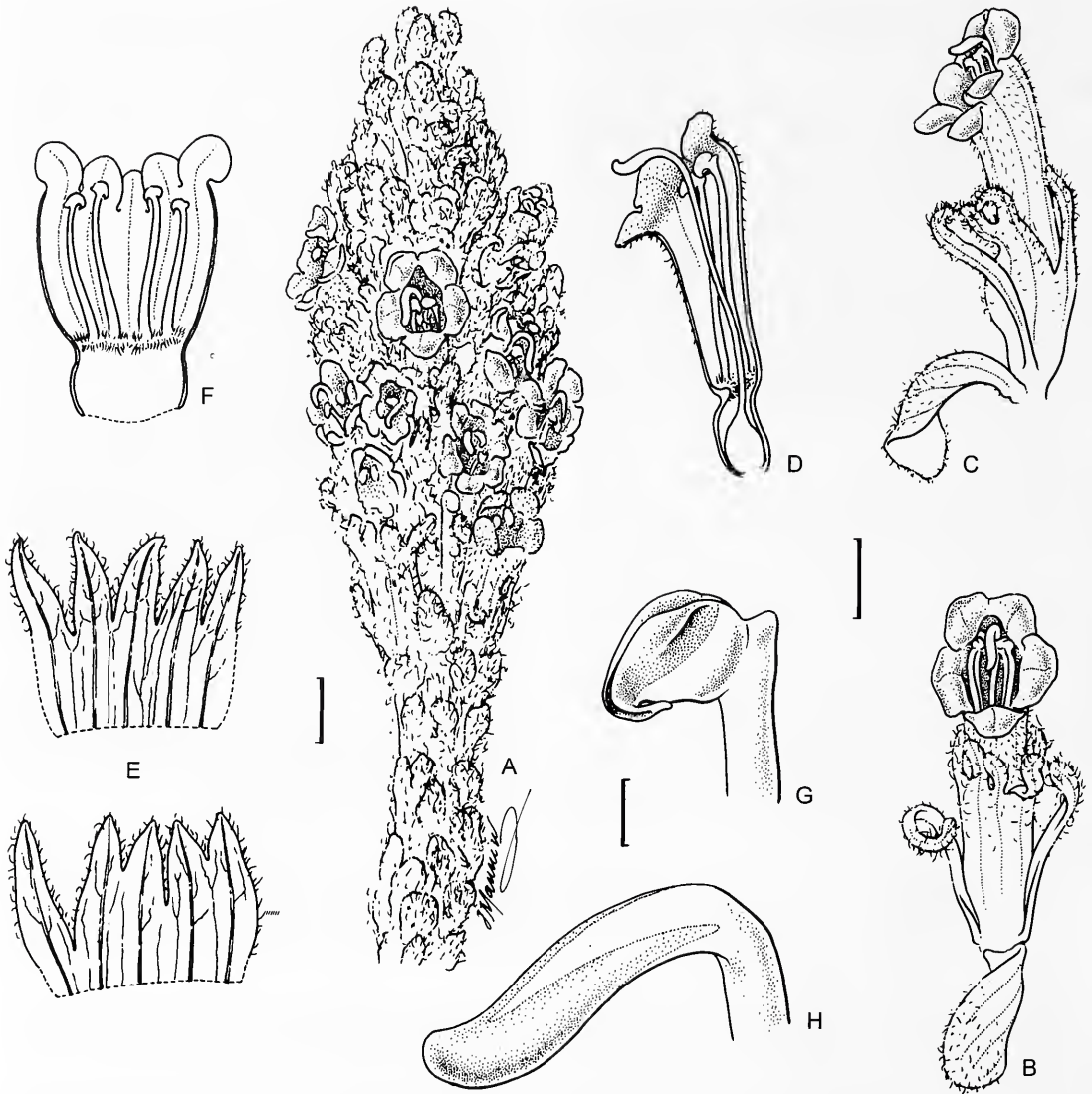


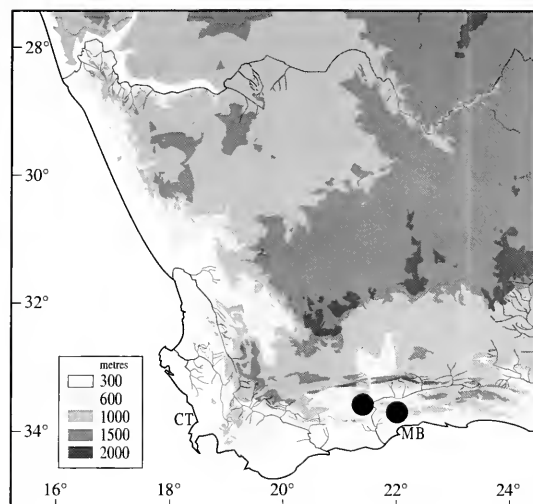
FIGURE 12.—*Harveya rosealba*, Goldblatt & Vlok 12547. A, whole plant. B–D, flower: B, front view; C, side view; D, l/s. E, calyces from two different flowers laid out; F, corolla laid out; G, anther; H, stigma. Scale bars: A–F, 10 mm; G, H, 1 mm. Artist: John Manning.

campanulato,  $25\text{--}30 \times \pm 10$  mm, glabrescenti ad basem, adaxialiter glabrato,  $\pm$  aequilobato usque ad medium, sepalis deltoideis ad linearo-lanceolatis vel bilabiatis, sepalo posteriore longissimo; tubo corollae pallide viride, anguste et oblique campanulato, 38–40 mm longo, circa 10 mm supra basin constricto, interne glabrato praeter annulum setarum ad partem constrictum, petalis 5(6–7) albis sub anthesi, postea erubrescentibus, subaequalibus, patentibus, suborbicularibus,  $5\text{--}6 \times 5\text{--}6$  mm; staminibus subdidynamis, in quarta parte inferiore tubi corollae ad annulum setarum insertis, antheris glabratibus theca fertili una  $\pm 2.5$  mm longa, subulata, ad basem uncinata et theca sterili ad lobum perparvum deminuta; stigmatibus valde decurvato, oblongo,  $5 \times 1$  mm.

Plants holoparasitic, 100–180 mm high, all parts deep pink to carmine red except corolla, densely viscid-villous or -lanate. Stem fleshy, simple, 15–25 mm diam.; caudal

scales imbricate, reduced below, grading into floral bracts above, concave, lower scales transversely obovate, upper scales obovate,  $5\text{--}15 \times 5\text{--}9$  mm. Inflorescence a dense spike or spike-like raceme of 25–50 flowers, all subsessile or lowermost shortly pedicellate with pedicels up to 5 mm long; bracts sessile, adpressed, obovate-rhomboidal, concave,  $15\text{--}25 \times 10\text{--}15$  mm, fleshy, densely villous abaxially, glabrous adaxially; bracteoles arising from base of calyx or on pedicel if present, opposite, linear-oblongate,  $20\text{--}25 \times 3\text{--}4$  mm, canaliculate, densely villous abaxially, glabrous adaxially. Calyx campanulate,  $25\text{--}30 \times \pm 10$  mm, densely villous adaxially above but glabrescent towards base, glabrous abaxially, variously lobed, varying from  $\pm$  equally lobed for up to halfway with all lobes deltoid or lanceolate to linear-lanceolate,  $7\text{--}10 \times 2\text{--}4$  mm, or bilabiate with anterior lip comprising four lobes divided for quarter to halfway and a single posterior lobe divided from anterior lip for three



FIGURE 13.—Distribution of *Harveya roseoalba*.

quarters. *Corolla*: tube pale greenish, narrowly and obliquely funnel-shaped,  $\pm$  straight or slightly curved at mouth, 38–40 mm long dorsally and 25–30 mm long ventrally, 5–6 mm diam. at base, constricted  $\pm$  10 mm from base and then gradually expanded to apex, mouth oblique, 8–10 mm diam., pubescent in upper half but glabrescent below, glabrous internally with exception of dense ring of stiff hairs encircling tube at point of constriction; limb white in bud and at anthesis but later turning pink, 5(6 or 7)-lobed, usually bilabiate with 2-lobed upper lip and 3-lobed lower lip; lobes subequal, patent, suborbicular, 5–6  $\times$  5–6 mm, glandular-hairy on both sides with shorter hairs on adaxial surface. *Stamens* arising in lower quarter of corolla tube at constriction among ring of hairs, subdidynamous, shorter anterior pair  $\pm$  20 mm long, posterior pair exceeding anterior by  $\pm$  1 mm, exerted for up to 4 mm; filaments linear, glabrous; anthers glabrous, 1-theous with sterile theca reduced to minute deltoid protrusion, fertile theca subulate-fusiform, hooked at apex and dehiscing from apical suture,  $\pm$  2.5 mm long. *Ovary* subglobose,  $\pm$  4 mm diam., glabrous; style exerted,  $\pm$  25 mm long, strongly decurved apically, glabrous; stigma oblong to slightly clavate, 5  $\times$  1 mm. *Fruit and seeds* unknown. *Flowering time*: September to October. Figure 12.

*Distribution and ecology*: *Harveya roseoalba* appears to be a local endemic of the Gamkaberg and adjacent Attakwasberg in the central Little Karoo, south of Oudtshoorn (Figure 13). Recorded hosts are *Phyllica lanigera* (Rhamnaceae) and *Hermannia velutina* (Malvaceae).

*Diagnosis and relationships*: this distinctive species is readily recognized by its bicoloured, spiciform inflorescence in which the white or cream-coloured corollas of the fresh flowers contrast strongly with the deep pink to carmine bracts and calyces. With age the flowers turn pink and then blend in with the rest of the inflorescence. In general appearance the dense, reddish spike of *H. roseoalba* recalls the genus *Hyobanche* L., with which it also shares a 1-lobed anterior calyx lip and 1-theous anthers. In *Hyobanche*, however, the corolla is  $\pm$  3-lobed, and there is no doubt that *H. roseoalba* is appropriately

placed in *Harveya*.

*Harveya roseoalba* is most similar to *H. hyobanchoides*, with which it shares a dense, spiciform inflorescence bearing narrowly funnel-shaped flowers with relatively small corolla lobes, stamens that arise in the lower quarter of the tube from a ring of stiff hairs, and an oblong stigma. In addition, the 1-lobed anterior calyx lip of *H. hyobanchoides* is sometimes evident in *H. roseoalba*, although the latter species is rather variable in the division of the calyx. *Harveya roseoalba* is also variable in the number of corolla lobes, which may number 6 or 7 in the upper flowers of some spikes. The two species are well-separated geographically, with *H. hyobanchoides* restricted to the southeastern seaboard, from Humansdorp to East London (Goldblatt & Manning 2000). *Harveya roseoalba* is readily distinguished from *H. hyobanchoides* by its white, rather than yellow to yellow-green corolla, completely glabrous adaxial surfaces of the bracts, and by the truly 1-theous anthers in which the second theca is completely absent and represented merely by a minute bump on the connective. The only other species in the genus with 1-theous anthers, *H. speciosa* Bernh., is a very different plant from the Drakensberg of KwaZulu-Natal and Eastern Cape, in which the sterile theca has apparently been independently lost.

#### Other material examined

WESTERN CAPE.—3321 (Ladismith): Gamka Nature Reserve, (–DA), eastern slopes in clay soil, 14 September 1981, J.H.J. Vlok 312 (NBG); mountain west of Fouriesberg near Cloete's Pass, (–DD), September 2003, A. Mohl s.n. NBG195623 (photo.).

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## SALICACEAE

SALIX: THE CORRECT APPLICATION OF THE NAME *SALIX MUCRONATA*, AND A NEW COMBINATION

Because of its heterophylly, *Salix* in southern Africa has been subject to considerable name changes and dissimilar species concepts. Thunberg (1794, 1807) collected and described four species of *Salix* from the Cape, *S. aegyptiaca*, *S. mucronata*, *S. capensis* and *S. hirsuta*. Burt Davy (1922) sank *S. aegyptiaca* into *S. mucronata* but recognized 10 species and varieties in South Africa. Thunberg provided no locality data for the type of *S. mucronata* but the type of *S. aegyptiaca* was collected from Roodesand in the Tulbagh Division. Burt Davy concluded that the type of *S. mucronata* also came from the vicinity of Tulbagh.

Immelman (1987) recognized only one species, *S. mucronata* with five subspecies. Jordaan (2002a, b) further reduced this number to four subspecies, sinking subsp. *wilmsii* into subsp. *woodii*. From Jordaan (2002a, b), we concluded that there is no meaningful difference between *S. mucronata* subsp. *mucronata* and subsp. *capensis*. Since *S. mucronata* is the oldest name for the taxon occurring in the southern most parts of southern Africa, this name has priority.

*Salix subserrata* is the present accepted name for the widespread tropical taxon occurring from Arabia to possibly the Cape (Wilmot-Dea 1991). Burt Davy recognized this as a tropical African species under the later name of *S. safsaf* Willd. Both Immelman and Jordaan reduced *S. subserrata* to synonymy under subsp. *mucronata*. Furthermore, Jordaan treated *S. mucronata* subsp. *mucronata* as a widespread tropical taxon, which, in the *Flora of southern Africa* region only occurs in the northern parts of Namibia and Botswana, but neither of these two authors discuss their reasons for sinking *S. subserrata*. However, Wilmot-Dea (1991) stated that the two species, *S. subserrata* and *S. mucronata* are very similar and may yet prove to be conspecific. Burt Davy (1922) and Wilmot-Dea (1991) stated that *S. woodii* intergrades with typical *S. subserrata* in Zimbabwe.

Thus numerous authors in various ways imply that *S. mucronata* is related to or cannot be kept specifically distinct from *S. subserrata*. It would therefore be prudent to maintain *S. subserrata* as a subspecies under *S. mucronata* until a detailed study of the variation of the species in the whole of southern and tropical Africa can be under-

taken. For a full description of the taxon *S. mucronata*, see Jordaan (2005).

The following new combination and synonymy is effected here.

***Salix mucronata* Thunb. subsp. *mucronata*.** Immelman: 173 (1987) p.p. (excluding tropical elements). Type: *Thunberg s.n.*, sheet annotated '*Salix mucronata* ♀' (UPS23065, lecto.; IDC microfiche 1063/968!).

*Salix mucronata* subsp. *capensis* (Thunb.) Immelman: 173 (1987); Jordaan: 255 (2002a); 122 (2002b), syn. nov. Type: Cape Province, near rivers in mountains near Hantam, *Thunberg s.n.* (UPS22958, lecto. designated by Jordaan (2005); IDC microfiche 1063/963!).

***Salix mucronata* Thunb. subsp. *subserrata* (Willd.) R.H.Archer & Jordaan, stat. et comb. nov.**

*Salix subserrata* Willd. in *Species plantarum* 4: 671 (1806). Wilmot-Dea: 1 (1985); 121 (1991). Type: Egypt, near Cairo, Bulak, *Herb. Willd. 18137* (B-WILLD, holo.; IDC microfiche 7440-30/1313!).

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# The systematic value of the leaf indumentum in *Lobostemon* (Boraginaceae)

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**Keywords:** Boraginaceae, indumentum, leaves, *Lobostemon* Lehm., trichomes

## ABSTRACT

The character states pertinent to the indumentum of *Lobostemon* Lehm. leaves are tabulated and discussed. *Lobostemon* possesses similar trichome and indumentum types as described for *Echium* L., with the exception of the 'Alpine' indumentum type. Due to the environmentally induced variation, the leaf indumentum characters of *Lobostemon* are viewed to be of limited phylogenetic value, although they do diagnose a number of taxa.

## INTRODUCTION

In terms of *Lobostemon* Lehm. systematics, the most recent revision by Levyns is noteworthy because she delimits five sections based on floral characters and presents a branching diagram (Levyns 1934: 412) to elucidate relationships within the genus. The aforementioned constitute falsifiable hypotheses.

One of the most striking features of the herbaceous forms of the Boraginaceae is the covering of thick-walled, harsh, unicellular trichomes (Metcalfé & Chalk 1950: 945), so much so that Klotz (1959) was of the opinion that one cannot ignore these characters when studying the Boraginaceae. Numerous studies of the leaf indumentum in the Boraginaceae have been undertaken e.g. Revedin (1902), Jonová (1926), Bider (1935), Klotz (1959), Lems & Holzapfel (1968), Bramwell (1972) and Selvi & Bigazzi (2001). Yet, opinions differ with regard to the taxonomic value of these characters. Because the largely European *Echium* L. is considered to be a sister taxon of the South African endemic *Lobostemon* (Böhle *et al.* 2001), the focus henceforth will for the moment fall on *Echium*. Klotz (1959), during his revision of the genus, used indumentum and trichome characters to key out species, series and sections. Lems & Holzapfel's (1968) in depth study of the genus on the Canary Islands, leads to an optimistic view about their use, claiming that there are at least 14 criteria which can be applied in comparing the Canary Island *Echium* species with one another, including not only the types of trichomes present, but their relative abundance, their total coverage of the leaf surface, the size of the pustules, and the orientation of the trichomes. Gibbs (1971: 31, 32), confining himself to the Spanish echiums, formed three groups based on indumentum characters and used a number of characters to key out species. Bramwell (1972), working in Macaronesia, chose to differ and suggested that the indumentum: 'is more or less useless and certainly of secondary importance ... in the consideration of the evolutionary and ... the phenetic relationships'.

Levyns (1934), for the first time in *Lobostemon*, mentioned that indumentum and trichome characters are particularly influenced by environmental and temporal factors. Failure to realise this earlier led especially De Candolle (1846) and Wright (1904) to describe a myriad of names, most of which were placed in synonymy by Levyns (1934: 403). Levyns (1934), in certain instances, still made use of vegetative characters in her key, e.g. in the section *Trichotomi* Levyns. Difficulty in identifying species using this key invariably occurs when using vegetative characters like indumentum or trichome type.

While it is true that like all taxonomic criteria, epidermal characters must be interpreted with great circumspection, Barthlott (1981) voiced the opinion that the major problem in their systematic application is that we do not yet have enough data [compare also Cole & Behnke (1975)]. Despite the vast amounts of SEM micrographs published, many of the data are not comparable because of a lack of standardized terminology and often no structural interpretation of the characters illustrated.

In the light of the aforementioned, this paper aims to contribute to epidermal related data in the Boraginaceae. Existing terminology is followed as far as possible, and for this reason is expanded in Material and methods below. Two issues are investigated, namely: 1, can SEM analyses of indumentum characters reveal states that can diagnose *Lobostemon* species, and 2, does the grouping of taxa based on these characters correlate with existing hypotheses of infrageneric relationships within the genus?

## MATERIAL AND METHODS

Voucher specimens were collected for all taxa examined and are listed in Table 1.

Material collected from plants in their natural habitat in the field was fixed in FAA. The indumenta of the fixed leaves were studied with a JOEL scanning electron microscope (SEM), using secondary-electron detection and an acceleration voltage of 4–5 kV. All fresh material used in the SEM study was collected during the peak flowering season between August and October. Additional observations were made with a light microscope on herbarium

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specimens as well as on potted plants. In the latter case, both young to mature leaves were analysed.

Terminology

Lems & Holzapfel (1968) and Bramwell (1972) identified three basic trichome types in Macaronesian species of *Echium*:

*Glandular trichomes* (Gl) occur mainly on the abaxial surface of the midrib or more rarely over wide areas of the abaxial surface of the leaf in most of the Macaronesian species of *Echium*. Selvi & Bigazzi (2001) distinguished two types of glandular trichomes in the genera of the tribe Boragineae: Type 6 trichomes consisting of a single stalk cell, and Type 7 trichomes consisting of three or more stalk cells.

*Simple trichomes* (Si) correspond to the Type 3 trichomes of Selvi & Bigazzi (2001). They are mostly short, stiff, hollow trichomes without a large pustular base, and are present in the cotyledons of all the *Echium* species. However, they do not persist into the adult stage in all species. Simple trichomes occurring in mature leaves are usually short, often curved and closely appressed to the leaf surface [the appressed trichomes correspond to the Type 2 trichomes of Selvi & Bigazzi (2001)]. Though the base of the trichome is usually swollen, there is generally little or no cell differentiation of the surrounding epidermal cells. Lems & Holzapfel (1968) record simple trichomes longer than 400 µm always possessing one or more rows of differentiated cells around the base. It is well established that

the number of rows of epidermal cells involved in the pustule formation in the Boraginaceae is a product of environmental and temporal variables.

*Pustular trichomes* (Pu), a term coined by Lems & Holzapfel (1968), correspond to the *Hügelborsten* of Bider (1935), nodular bristles of Metcalfe & Chalk (1950), *Höckerborsten* of Klotz (1959) and Type 1 trichomes of Selvi & Bigazzi (2001). One or more concentric rings of strongly differentiated epidermal cells which contain cystolith-like structures and whose walls are strongly impregnated with calcareous material surround the bases of the hollow, pustular trichomes. In very large trichomes, some of the cells of the upper palisade layer of the mesophyll are also involved in the pustule structure and may also be calcified. Uphof (1962) referred to these subepidermal areas as pedestals.

Lems & Holzapfel (1968) furthermore discerned four main indumentum types in the Boraginaceae:

*Spinous indumentum* (Sp) consists of stiff spines and is found on the leaf surface or is often confined to the margins and the midrib of the leaf;

*Appressed to ascending silky indumentum* (Ap). Here the leaf surface is covered with a dense layer of appressed trichomes that are either simple or with small basal cells;

*Umbonate indumentum* (Um), spinous, consisting of relatively sparsely distributed pustular trichomes with a large, round, basal region on the otherwise glabrous leaf surface. I designate the term umbonate to describe this type of indumentum. Klotz (1959) referred to these as

TABLE 1.—Distribution of indumentum types and trichome characteristics in *Lobostemon* (with voucher specimens housed in NBG)

Taxa	Voucher specimens	Indumentum type			Trichome type			Trichome length		Trichome distribution		Micropapillae presence and type		
	MHB	Sp	Ap	Um	Gl	Si	Pu	1	2	Ad	Ab	No	Sm	Un
<i>L. argenteus</i>	436	•	•		•	•	•		•	•	•	•		
<i>L. belliformis</i>	432	•			•			•		•	•			•
<i>L. capitatus</i>	503	•			•		•			•	•		•	
<i>L. collinus</i>	505	?			?		•	•		•	•			
<i>L. curvifolius</i>	392	•	•		•		•	•		•	•		•	
<i>L. daltonii</i>	501	•			•	•	•	•		•	•		•	
<i>L. decorus</i>	422	•			•		•	•		•	•	•	•	
<i>L. echioides</i>	403	•	•		•	•	•	•		•	•		•	
<i>L. fruticosus</i>	385	•	•		•	•	•		•	•	•		•	
<i>L. glaber</i>	417	•		•	?		•	•		•	•		•	
<i>L. glaucophyllus</i>	384	•		•	•	•	•	•		•	•		•	
<i>L. gracilis</i>	443		•		•	•	•	•		•	•		•	
<i>L. hottentoticus</i>	379	•		•	?	•	•	•		•	•		•	
<i>L. laevigatus</i>	519	•		•	?	•	•	•		•	•		•	
<i>L. lucidus</i>	446	•			•		•	•		•	•		•	
<i>L. marlothii</i>	419	•			•		•	•		•	•	•	•	
<i>L. montanus</i>	382	•	•		•		•	•		•	•		•	
<i>L. murii</i>	413	•			•		•	•		•	•	•		
<i>L. oederiaefolius</i>	396	•			•		•	•		•	•	•		
<i>L. paniculatus</i>	421	•		•	•	•	•		•	•	•		•	
<i>L. paniculiformis</i>	508	•		•	•	•	•	•		•	•		•	
<i>L. pearsonii</i>	515	•		•	?	•	•	•		•	•		•	
<i>L. regulareflorus</i>	439			•	•		•	•		•	•	•		
<i>L. sanguineus</i>	447		•		?		•	•		•	•	•		
<i>L. stachydeus</i>	420	•			•	•	•		•	•	•		•	
<i>L. strigosus</i>	387	•					•	•		•	•		•	
<i>L. trichotomus</i>	377		•		?	•	•	•		•	•		•	
<i>L. trigonus</i>	425	•	•		•		•	•		•	•		•	

MHB, M.H. Buys; Sp, spinous; Ap, appressed; Um, umbonate; Gl, glandular; Si, simple; Pu, pustular; 1, homomorphic or with a continuous variation; 2, dimorphic; Ad, adaxial; Ab, abaxial; No, without papillae; Sm, smooth papillae; Un, undulate papillae.



FIGURE 1.—*Lobostemon reguleiflorus*: *t/s* through leaf showing involvement of underlying parenchyma in pustule formation. Scale bar: 50 μm.

*diskusartig* bases. Selvi & Bigazzi (2001) referred to the trichomes forming this indumentum type as Type 4 trichomes;

*Alpine indumentum* (AI), dense, ascending to erect, with long trichomes with small bases, found only in sub-alpine zone species.

Trichome and indumentum types were identified according to those recognized by Lems & Holzapfel (1968). All observations of indumentum presence, abundance and type were confined to the surface of the lamina (excluding margins). Leaves were considered to be glabrous when no sign of any trichomes could be seen (including on the midrib) with a light microscope or SEM.

Transverse sections of paraffin wax-embedded laminae were cut with a rotary microtome and stained with a mixture of Safranin O and Alcian green (Joel 1983). Sections were taken through the middle of the laminae.

The cluster analysis was done using the Statistica 6.1 package with the following settings: tree clustering; Ward's (1963) method of minimum-variance clustering under the amalgamation rule and percentage disagreement as a measure of distance. Characters were coded as qualitative presence/absence data. Data for the spinous indumentum type and glandular trichome type were excluded from the analysis due to the presence of unknown/uncertain states in one or more taxa.

RESULTS

Table 1 presents a summary of the various leaf indumentum and trichome characters codified for *Lobostemon*.

Trichomes

In *Lobostemon*, the tendency for epidermal cells at the base of the trichomes to become organized into pustules extends sometimes to several concentric rows, the number of which seem to vary with the climatic conditions under which the plant grew and the stage of ontogenetic development. Trichomes typically longer than 400 mm tend to develop pustular bases. In trichomes with a large base, the underlying parenchyma also becomes involved in pustule formation (Figure 1). The pustular trichome type occurs in all *Lobostemon* species (Figure 2). Most of the species in *Lobostemon* possess glandular tri-

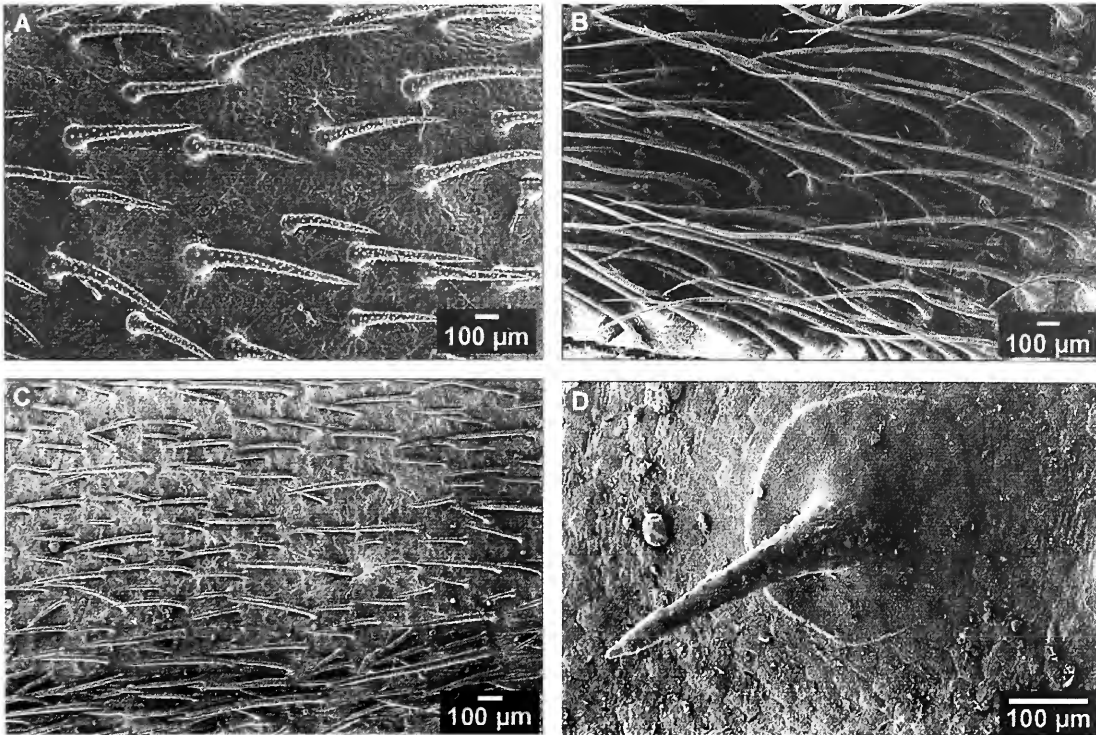


FIGURE 2.—Indumentum types in *Lobostemon* leaves. A, spinous in *L. belliformis*; B, appressed in *L. montanus*; C, appressed in *L. trichotomus*; D, umbonate in *L. paniculatus*. Scale bars: 100 μm.



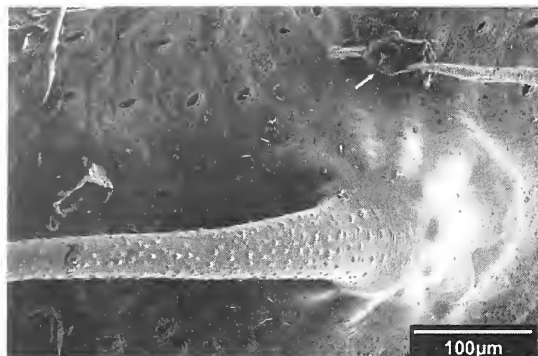


FIGURE 3.—Collapsed glandular trichomes in *Lobostemon fruticosus* indicated by arrow. Scale bar: 100 μm.

chomes on their leaf surfaces. These trichomes have a tendency to fall flat from an early age (Figure 3).

#### Length

With regards to the leaves, only four species of *Lobostemon*, namely *L. argenteus* (P.J.Bergius) H.Buek, *L. fruticosus* (L.) H.Buek, *L. paniculatus* (Thunb.) H.Buek and *L. stachydeus* A.DC. clearly possess a dimorphic indumentum in the adult stage (Figure 4A). The shorter trichome is usually of the simple trichome type. Some forms of *L. echinoides* Lehm., *L. gracilis* Levyns, *L. trichotomus* (Thunb.) A.DC. and *L. paniculiformis* A.DC. possess a heteromorphic indumentum. Here the variation in trichome length is discerned to be continuous (Figure 4B).

#### Distribution

Species with trichomes on both the abaxial and adaxial leaf surfaces are the most common. *L. regulareflorus* (Ker Gawl.) M.H.Buys is unique in only its adaxial leaf surface being hairy. *L. collinus* C.H.Wright is a good example of how climate or age can influence trichome distribution. Plants collected in spring generally have both sides of the leaf hairy. Those collected in late summer (January–April) have glabrous adaxial surfaces. In *L. capitatus* (L.) H.Buek, however, the opposite holds true. Young leaves collected in spring appear to be hairy only on the abaxial surface. Older leaves from the previous year's growth are hairy on both the adaxial and abaxial surfaces.



#### Micropapillae

Only a limited number of species seem to have trichomes without micropapillae (Figure 5A). In the majority of taxa, trichomes examined in young leaves as well as flower buds display micropapillae. Micropapillae may either be smooth (Figure 5B) or undulated (Figure 5C). In terms of shape, both round and elongate micropapillae have been observed on single trichomes (Figure 5D). The round micropapillae in the aforementioned figure are confined to the base of the trichome, whereas the elongate micropapillae occupy the distal parts. *L. decorus* Levyns and *L. marlothii* Levyns have been observed to possess trichomes with or without micropapillae.

#### Indumentum

Three main indumentum types can be recognized in the genus. The spinous indumentum type (Figure 2A) is the most prevalent. The appressed indumentum type (Figure 2B) is commonly found on those taxa exhibiting silvery leaves. Forms of *L. argenteus*, *L. curvifolius* H.Buek, *L. echinoides*, *L. fruticosus* and *L. trigonus* (Thunb.) H.Buek that grow in less arid and more sheltered conditions tend to have appressed trichomes. Generally appressed indumenta also become more spinous as the season progresses, i.e. as it becomes drier and warmer. *L. trichotomus* and *L. gracilis* appear to be the only species with an appressed indumentum without an accompanying complement of spinous indumentum (Figure 2C). The umbonate indumentum type is the most difficult to identify due to the general absence of calcified cells around the trichome bases (Figure 2D). This indumentum type appears to be absent from sections *Argentei* Levyns and *Fruticosi* Levyns, but most prevalent in section *Trichotomi* Levyns. Only *L. regulareflorus* and *L. sanguineus* Schltr. appear to possess an umbonate indumentum type to the exclusion of a spinous indumentum on the leaf surfaces. The remainder of species generally have a spinous indumentum on the margins in addition to the umbonate indumentum of both leaf surfaces. Although the leaves of *L. glaucophyllus* (Jacq.) H.Buek appear to be glabrous to the naked eye, this study has shown the prevalence of minute umbonate indumentum on especially the abaxial surface (Figure 6).

A cluster analysis of the data in Table 1 (excluding characters with unknown/uncertain states) created a number of clusters with taxa possessing identical character states viz.:

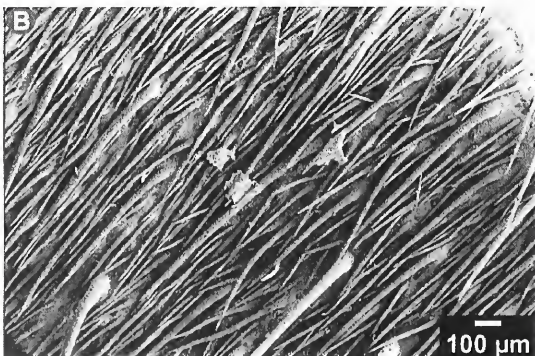


FIGURE 4.—Trichome lengths in *Lobostemon*. A, dimorphic in *L. argenteus*; B, continuous in *L. echinoides*. Scale bars: 100 μm.



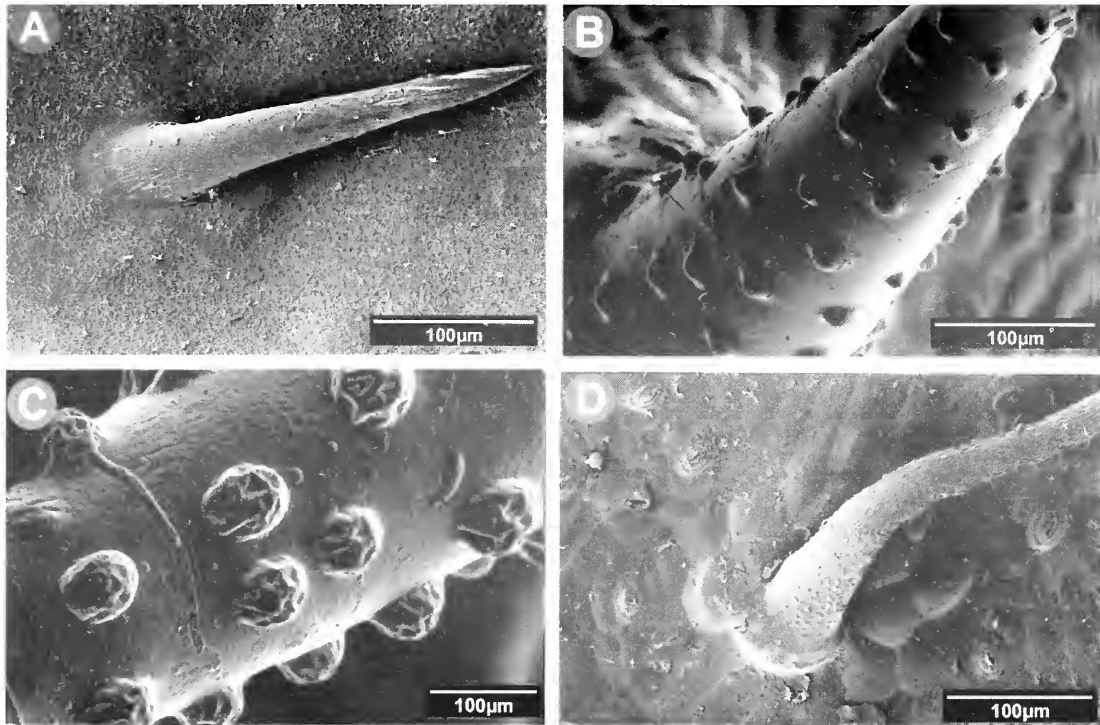


FIGURE 5.—Trichome micropapillae in *Lobostemon*. A, no micropapillae in *L. muirii*; B, round and smooth in *L. paniculatus*; C, round and undulate in *L. belliformis*; D, round and elongate smooth in *L. curvifolius*. Scale bars: 100 µm.

*L. argenteus* and *L. fruticosus* cluster; *L. capitatus*, *L. collinus*, *L. lucidus* (Lehm.) H.Buek and *L. strigosus* (Lehm.) H.Buek cluster; *L. curvifolius*, *L. montanus* H.Buek and *L. trigonus* cluster; *L. echioides*, *L. gracilis* and *L. trichotomus* cluster; *L. glaucophyllus*, *L. hottentoticus* Levyns, *L. laevigatus* (L.) H.Buek, *L. paniculiformis* A.DC. and *L. pearsonii* Levyns cluster; *L. muirii* Levyns and *L. oederiaefolius* A.DC. cluster (Figure 7).

DISCUSSION

I alluded above to Barthlott's (1981) reasons as to why indumentum and trichome characters have not been applied to systematics with great success. Following this study, and those by Levyns (1934) and Bramwell (1972),

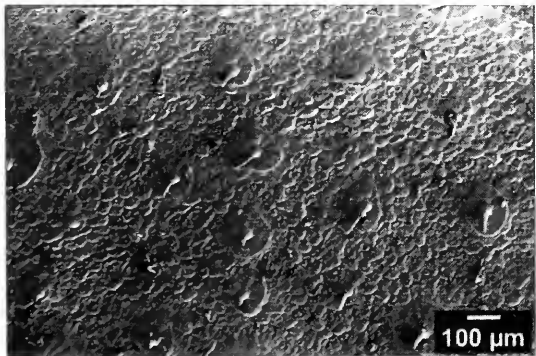


FIGURE 6.—Minute umbonate indumentum on abaxial leaf surface of *Lobostemon glaucophyllus*. Scale bar: 100 µm.

it seems clear that in the absence of data to the contrary, a lack of knowledge concerning the influence of habitat and ontogenetic development probably more than anything else places a damper on the use of indumentum and trichome data for systematic studies in the Boraginaceae. However, even though there is uncertainty about their systematic use, and grouping of plants based on epidermal features does not agree with those based on reproductive features, the need remains to provisionally describe and organize into a system, all data whereby relationships between the various patterns can be meaningfully approached in the future (Klucking 1995).

This study has revealed that trichomes in *Lobostemon* should not be defined as purely epidermal but rather as emergences. In *Lobostemon*, young plants possess straight, simple, unicellular trichomes (Table 1: Si) whose swollen bases are part of the epidermal layer. From this simple type, present on juvenile leaves, different developments may occur both in the ontogeny and in the transition from juvenile to adult foliage.

Most of the species in *Lobostemon* possess glandular trichomes on their leaf surfaces. By contrast, Klotz (1959) in his revision of the genus *Echium*, found the chief occurrence of glandular trichomes to be on the stems of *E. humile* Desf. and *E. trygorrhizum* Pomel, although *E. gaditanum* Boiss. was observed with glandular trichomes on their leaf surfaces.

Levyns (1934) correctly indicated that *Lobostemon* tends to undergo a second growing period later in the

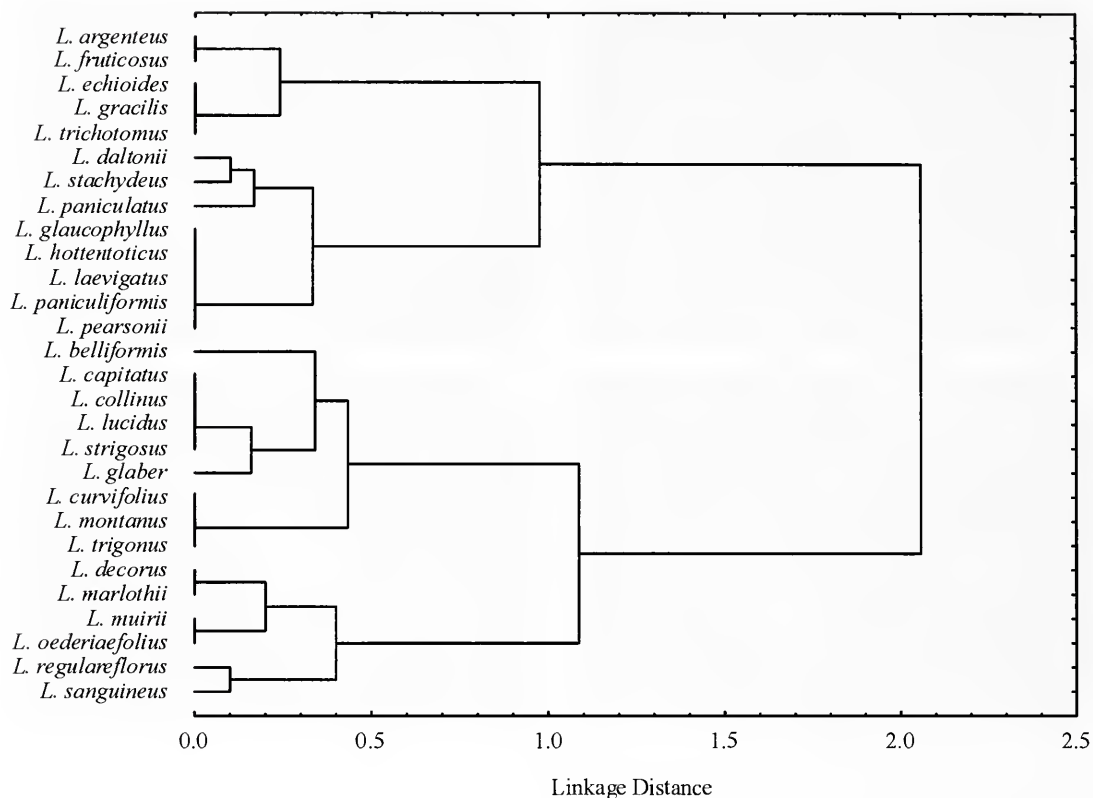


FIGURE 7.—A phenogram of *Lobostemon* based on indumentum characters employing Ward's method of minimum-variance clustering and percentage disagreement as a measure of distance.

season that results in the indumentum becoming sparser as the leaf size increases. Moreover, this study has shown that trichomes tend to fall or break off in some species of *Lobostemon*, leaving behind their hardened bases and manifesting a sparser coverage.

Some taxa can be diagnosed on a single or a combination of indumentum characters. The possession of a dimorphic indumentum in *Lobostemon* is confined to *L. argenteus*, *L. stachydeus*, *L. paniculatus* and *L. fruticosus*. *L. curvifolius* and *L. fruticosus* have often been mistaken for each other: the two taxa are distinguishable—the dimorphic indumentum being absent in *L. curvifolius*. *L. regulareflorus* and *L. belliformis* M.H.Buys, although morphologically similar, differ in that *L. belliformis* possesses trichomes on both leaf surfaces whereas *L. regulareflorus* possesses trichomes confined to the adaxial surface.

Keeping the shortcomings of phenetics in mind, the aforementioned cluster analysis created groups that could not be correlated to current sectional divisions *sensu* Levyns (1934: 412). Some clusters, however, can be found as subgroups within Levyns' sections e.g. the *L. decorus*, *L. marlothii*, *L. muirii* and *L. oederiaefolius* cluster and to an extent the *L. glaucophyllus*, *L. hottentoticus* Levyns, *L. laevigatus* and *L. paniculiformis* cluster. The *L. echiioides*, *L. gracilis* and *L. trichotomus* cluster, although not all members of the same section, represent the basal taxa in Levyns' branching diagram.

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# Ovule-to-seed development in *Dovyalis caffra* (Salicaceae: Flacourtiaceae) with notes on the taxonomic significance of the extranucellar embryo sac

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**Keywords:** *Dovyalis caffra* (Hook.f. & Harv.) Hook.f., embryology, Flacourtiaceae, Flacourtiaceae, Salicaceae, *Salix* L., seed coat, taxonomy

## ABSTRACT

*Dovyalis caffra* (Hook.f. & Harv.) Hook.f. is a widespread and horticulturally important southern African endemic. Here described, ovule-to-seed development represents the first embryological information on this genus of the tribe Flacourtiaceae, Salicaceae *sensu lato*. Results are discussed in the light of data available on the embryology of the order Malpighiales in general and on the tribe Flacourtiaceae in particular. It is clear that *Dovyalis* E.Mey. ex Arn. shares many characters with other members of the Flacourtiaceae. Ovules of *D. caffra* are anatropous, bitegmic and crassinucellate with both bisporic *Allium*- and monosporic *Polygonum*-type embryo sacs. One of the most characteristic embryological features of the tribe is the presence of an unusual, extranucellar embryo sac that stretches halfway up into the micropyle. Since this extraordinary-shaped embryo sac also defines the embryo sacs of *Salix* L. and *Populus* L., it is suggested that the character provides strong support for the proposed close phylogenetic link between tribes Flacourtiaceae and Saliceae of Salicaceae *sensu lato*.

## INTRODUCTION

*Dovyalis* E.Mey. ex Arn. is a relatively small, mostly African genus comprising about 15 species of shrubs or relatively small trees, often thorny, with simple, alternate and exstipulate leaves (Sleumer 1972). All species are dioecious or rarely polygamous (Langenegger 1976) with a tendency towards andromonoecy, i.e. the male plants occasionally bear a few bisexual flowers and fruits (Sleumer 1972). The apetalous flowers are unobtrusive, greenish, nectariferous and borne singly or in few-flowered fascicles. Fruits are indehiscent, fleshy and edible berries in various species. *Dovyalis* is widespread in tropical and subtropical Africa (excluding Madagascar), with one species reported from Sri Lanka (Sleumer 1972). Six species occur in the *Flora of southern Africa* region (Bredenkamp 2003) where they form a common constituent of mixed scrub, riverine bush, open woodland and forest.

When the genus was first validly described, Arnott (1841) regarded the type species, *Dovyalis zizyphoides* E.Mey. ex Arn., as closest to Euphorbiaceae with some resemblance in habit to *Flacourtia* L'Hér. Although Endlicher (1842) consequently listed *Dovyalis* as a dubious genus under his natural order Euphorbiaceae, the association with *Flacourtia* and a placement of *Dovyalis* in Flacourtiaceae DC. were subsequently endorsed by most taxonomists during the 19th and 20th centuries (see Warburg 1893 (as *Doryalis*); Gilg 1925; Hutchinson 1967; Lemke 1988). However, the beginning of the 21st century has seen a radical reshuffling of genera traditionally placed in Flacourtiaceae. Molecular phylogenetic

studies, supported by data from several other botanical fields, have indicated that most flacourtiaceous genera fall into two clades, each more closely related to other families within Malpighiales than to one another (Chase *et al.* 2002). Flacourtiaceae were accordingly split into two groups and the flacourtiaceous genera (not *Aphloia* DC.) became part of two recircumscribed families, namely Achariaceae *sensu lato* and Salicaceae *sensu lato*. Consequently, all the southern African flacourtiaceous genera were placed in Salicaceae *sensu lato* with the exception of *Kiggelaria* L., *Rawsonia* Harv. & Sond. and *Xylothea* Hochst.; these three genera were included in Achariaceae *sensu lato* (Chase *et al.* 2002).

Recent studies on ovule-to-seed development and structure in the three southern African genera of the Achariaceae *sensu stricto* (Steyn *et al.* 2001, 2002a, b, 2003) and in *Kiggelaria* L. (Steyn *et al.* 2003), offer unequivocal embryological support for the proposed close phylogenetic relationship between the herbaceous, highly modified and monotypic genera of Achariaceae *sensu stricto* and the African genus *Kiggelaria* of the woody tribe Pangieae (Flacourtiaceae *sensu stricto*). These taxa share a number of uncommon embryological characters, e.g. sessile ovules with zigzag micropyles, deep-lying embryo sacs covered by an epistase in the ovule and seed, endotestal-exotegmic protective layers in the seed coat, suspensorless embryos and sarcotestal seeds with stomata in the epidermis (Steyn *et al.* 2003).

On the other hand, available embryological and other structural support for emending the circumscription of Salicaceae *sensu stricto* has been meagre and mainly rests on stamen and pollen characters (Keating 1973; Meeuse 1975; Kaul 1995; Bernhard & Endress 1999). Although Meeuse (1975) listed some ovule characters shared between Salicaceae *sensu stricto* and Flacourtiaceae *sensu stricto*, these characters are not restricted to the two taxa; they are commonly found among related violalean families (Meeuse 1975). Nevertheless, the strong similarity in embryological characters between Achariaceae *sensu*

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*stricto* and *Kiggelaria* (Steyn *et al.* 2003) suggests that detailed embryological studies of flacourtiaceous species representing the tribes assigned together with Saliceae Rchb. to Salicaceae *sensu lato* might also reveal characters that are diagnostic for Flacourtiaceae *sensu stricto* and Salicaceae *sensu stricto*. Such embryological characters would be useful for testing hypotheses by molecular phylogeneticists for a close evolutionary relationship between these two families.

Here we present data on ovule-to-seed development and structure in *Dovyalis caffra* (Hook.f. & Harv.) Hook.f., a representative of the tribe Flacourtieae DC. and a species that is, like all the other members of *Dovyalis*, embryologically completely unknown. Results are compared with findings recently obtained during a study of seed structure in the polymorphic African willow, *Salix mucronata* Thunb. (Steyn *et al.* 2004) and with information found in classic embryological literature on Salicaceae and Flacourtiaceae. Representatives of Flacourtieae are, according to data collected in multidisciplinary studies, including molecular phylogeny, possibly the closest relatives of *Salix* L. and *Populus* L., both of the tribe Saliceae (Chase *et al.* 2002).

*Dovyalis caffra* is the only southern African species of the genus that belongs to the section *Aberia* Hochst., the other five species represent section *Dovyalis* E.Mey. ex Arn. (Sleumer 1972). *D. caffra* occurs in the easternmost parts of Western Cape and is widespread in the eastern, subtropical regions of southern Africa, extending from Eastern Cape northwards through KwaZulu-Natal, Swaziland, Mpumalanga and Limpopo into Zimbabwe. Commonly known as the Kei apple, *D. caffra* is also often cultivated for its edible fruit and, because of its formidable thorns, frequently used as a security hedge.

#### MATERIAL AND METHODS

Floral buds, open flowers and developing fruits were collected from cultivated female trees of *Dovyalis caffra* growing in the Pretoria National Botanical Garden and in a private garden in Murrayfield, Pretoria. All flowering stages were dissected to facilitate penetration of chemicals into ovules and seeds and fixed in a 0.1 M cacodylate buffered solution containing 4% formaldehyde and 2.5% glutaraldehyde. Following the methods of Feder & O'Brien (1968), material was dehydrated in an alcohol series and impregnated with glycol methacrylate (GMA). All material was imbedded in GMA, sectioned transversely or longitudinally at 2–3 µm and subsequently stained with the periodic acid/Schiff reaction and toluidine blue by using the protocols of O'Brien & McCully (1981).

Seed coat terminology follows Corner (1976) as recommended by Schmid (1986).

#### RESULTS

##### Placentation, orientation and development of megagametophyte

The gynoecium in the apetalous female flowers (Figure 1A) of *Dovyalis caffra* is usually hexa- or heptacarpellate

and very rarely pentacarpellate. The syncarpous, unilocular and superior ovary is globose and glabrous (Figure 1B) with six or seven styles, each ending in a bifid stigma. Twelve to fourteen ovules, two per carpel, are borne on parietal placentae developing approximately at the same level,  $\pm$  halfway down the locule (Figure 1A, B). The ovules occur in pairs on the flanks of the fused carpel margins. These thick structures extend deeply into the locule (Figure 1A), limiting the space available to the developing ovules so that they show some spatial adjustment. Nevertheless, longitudinal sections showed that all ovule stages are epitropous with a ventral raphe *sensu* McClean & Ivimey-Cook (1956: 1392) and anatropous or about to become anatropous (Figure 1C).

The youngest buds examined contained bitegmic, crassinucellate young ovules in the process of curving towards the anatropous position (Figure 1C). The nucellus tissue holds a single megaspore mother cell covered by one or two parietal cell layers. At this early stage the ovule seems to be slightly stalked, but when the curvature is completed at about the time meiosis takes place, the ovule has no funicle (Figure 1D).

Meiosis does not seem to result in a linear tetrad of megaspores. After the first meiotic division, two dyad cells are formed of which the chalazal cell undergoes the second meiotic division, but mostly without the formation of a cell wall between the two megaspore nuclei (Figure 2A); in only one ovule a partitioning wall was seen resulting in two chalazal megaspores (Figure 2C). The micropylar dyad cell degenerates without further division (Figure 2B, C). The starting point of the megagametophyte is therefore usually a bisporic cell with the nuclei situated at opposite poles of the cell (Figure 2B). After two mitotic divisions an eight-nucleate, bisporic embryo sac is formed that conforms to the *Allium*-type of megagametophyte development (Willemse & Van Went 1984). However, the presence of three megaspores in the nucellus (Figure 2C) suggests that monosporic *Polonium*-type embryo sacs also occur in *Dovyalis caffra*.

##### Structure of the mature ovule

Ovules are pendant, sessile, ovoid and anatropous structures reaching a size of about 90 × 60 µm at anthesis (Figure 2D). The two integuments are of equal length so that the micropylar canal is formed by the inner integument only, but in post-fertilization stages the outer integument usually lengthens to form an exostome (compare Figure 2D, E) that is slightly out of line with the endostome. The lower part of both integuments consists of about five parenchymatic cell layers, but in the micropylar region the integuments become thicker (Figure 1D). The outer epidermis of the inner integument is the most prominent of the integumental layers. The lower part of this epidermal layer is uniseriate and consists of meristematic cells with large nuclei and dense protoplasm, whereas the micropylar part is multiseriate and forms most of the cells in the thick micropylar region of this integument (Figure 2D). In the centre of the ovule, the nucellus is an ovoid structure with a slightly attenuate apex consisting of a nucellus cap. The latter is formed by derivatives of the nucellus epidermis and the parietal cell (Figure 2B, C). The nucellus cells are parenchymatic, except at the base of the



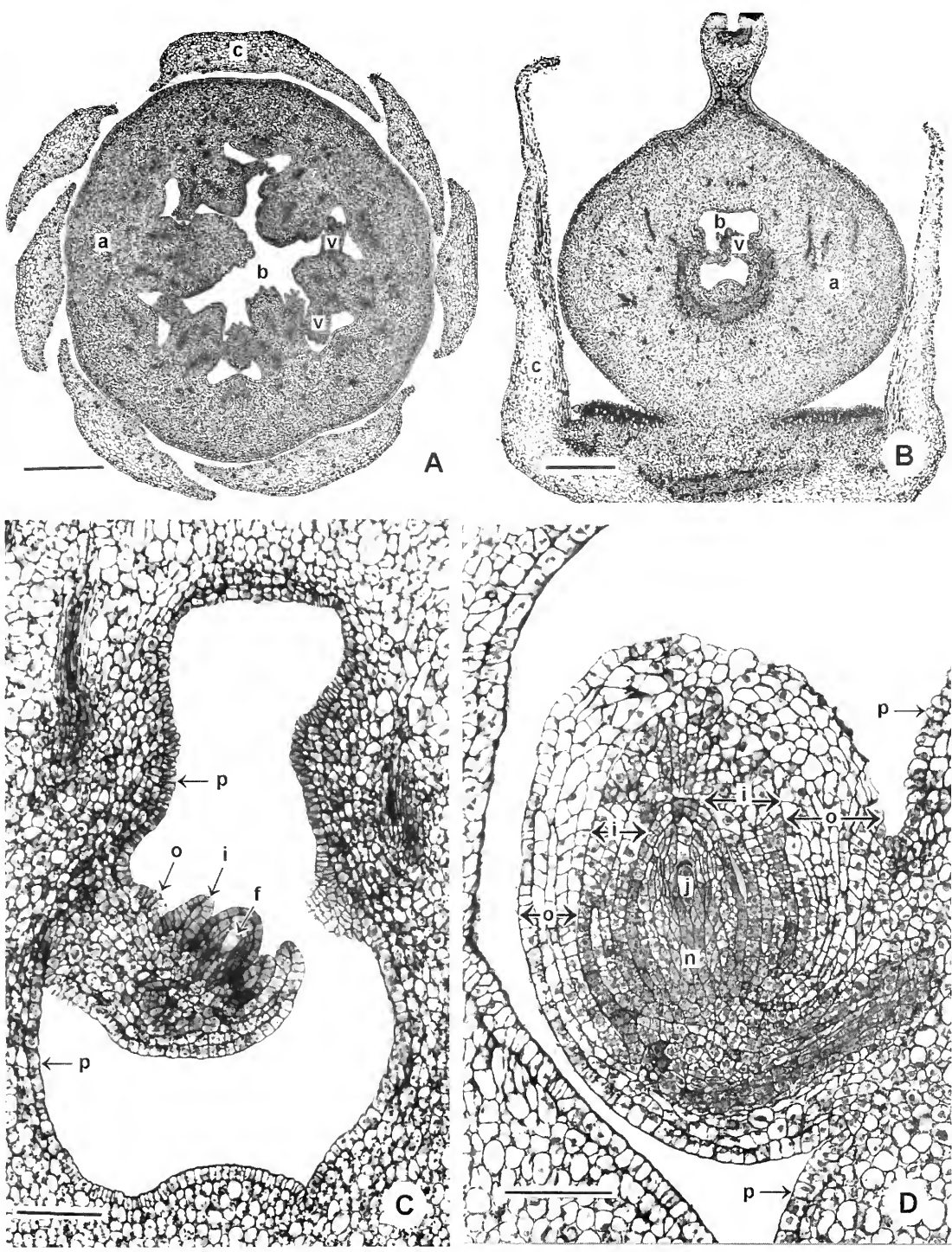


FIGURE 1.—Placentation and orientation of ovules in *Dovyalis caffra*. A, apetalous female flower in *ts* showing parietal placentation of developing ovules in unilocular ovary; B, female flower in superficial (tangential) *ts* showing position and orientation of young ovules; C, sagittal section of bitegmic, dorsal epitropous ovule primordium with megaspore mother cell; D, anatropous, crassinucellate, sessile ovule in sagittal section during formation of bisporic embryo sac. a, 6-carpellate ovary; b, locule; c, calyx lobe; f, megaspore mother cell; i, inner integument; j, initial stage of bisporic embryo sac; n, nucellus; o, outer integument; p, placenta of locule; v, young ovule. Scale bars: A, B, 50  $\mu$ m; C, D, 10  $\mu$ m.

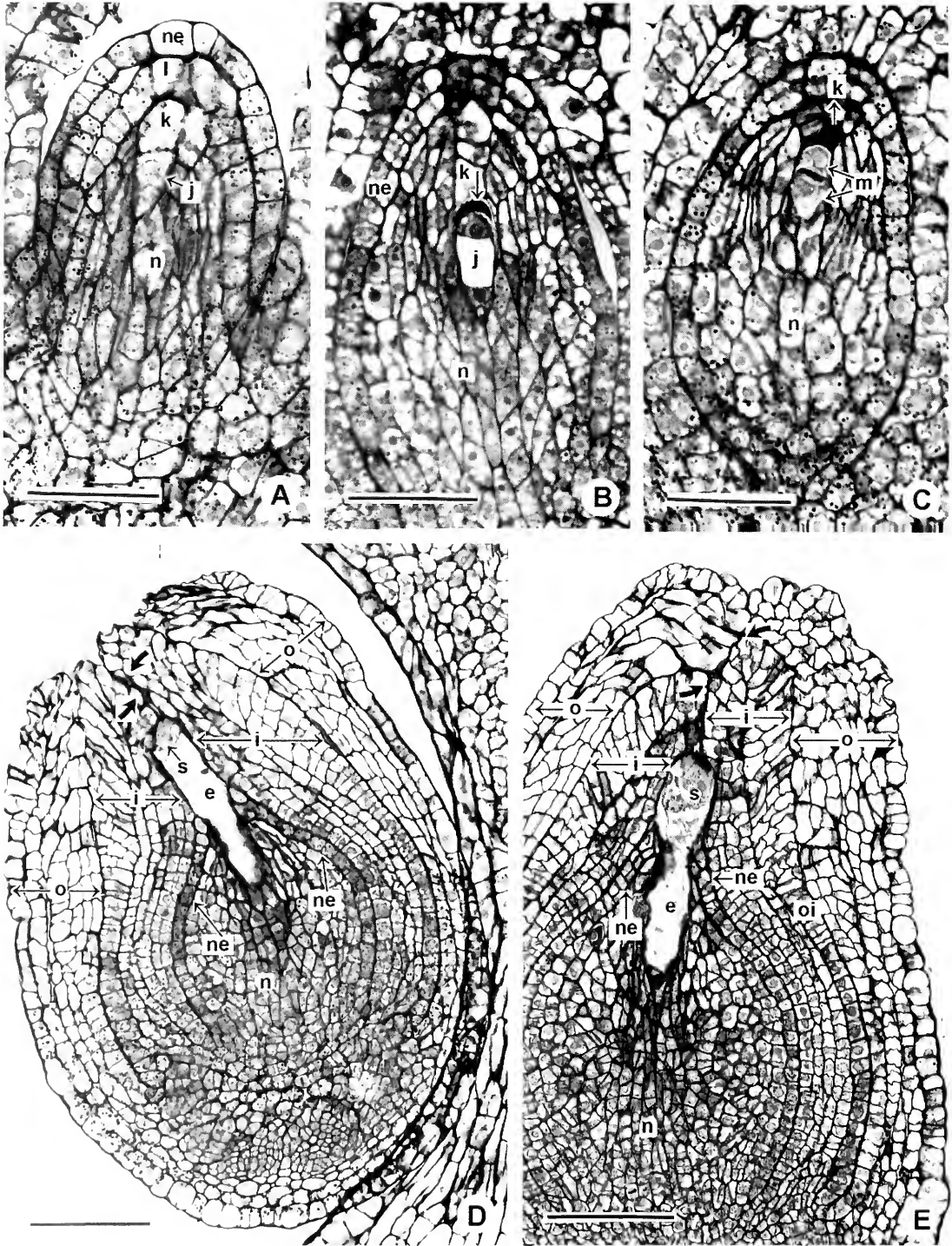


FIGURE 2.—Formation of embryo sac and structure of ovule in *Dovyalis caffra*. A, dyad cells in nucellus with chalazal cell containing two megaspore nuclei; B, nucellus containing bisporic embryo sac in two-nucleate stage and disintegrated micropylar dyad cell; C, nucellus with two chalazal megaspores and disintegrated micropylar dyad cell; D, structure of ovule at anthesis. Note micropyle (curved arrows) formed by inner integument and embryo sac protruding into lower part of endostome; E, embryo sac at fertilization. Note dark-staining filiform apparatus of synergid, extranucellar embryo sac and slightly skewed micropyle (curved arrows) formed by both integuments. e, embryo sac; i, inner integument; j, initial stage of bisporic embryo sac; k, disintegrated micropylar dyad cell; m, chalazal megaspores; n, nucellus; ne, nucellus epidermis; o, outer integument; oi, outer epidermis of inner integument; s, synergid. Scale bars: A, B, C, 5 µm; D, E, 10 µm.



embryo sac where the cell walls are noticeably thicker, darkly stained and possibly lignified (Figure 2D, E). The cells possibly represent a postament as described by Shamrov (1998: 379), i.e. a column-like tissue located below the sporogenous or gametophytic structures, consisting of thin-walled or sometimes lignified cells.

The mature embryo sac is a narrow-elliptical structure that occupies an unusual position in the ovule—it lies partly inside and partly outside the nucellar tissue (Figure 2D). In its growth towards maturity, the base of the embryo sac does not succeed in penetrating the chalazal nucellus, the thick-walled cells of the postament possibly acting as a barrier tissue to stop the encroachment of the embryo sac into the chalaza (McLean & Ivimey-Cook 1956; Bouman 1984). However, in the micropylar region the apical part of the embryo sac has broken through the nucellus epidermis and, flanked by the inner integument, stretches up halfway into the endostomium (Figure 2D, E). The detailed structure of the embryo sac elements could not be determined. At fertilization the antipodals have disappeared, the central cell nucleus lies near the egg apparatus in the extranucellar apical region and the synergids show the unmistakable presence of a filiform apparatus (Figure 2E).

### Seed development

*Embryo*: fertilized ovules take about three months to develop into mature, woolly seeds of  $\pm 10 \times 5$  mm, embedded in the fleshy pulp of the fruit, which is a berry. Embryo development was not studied in detail and the embryo could not be typified. The youngest embryo found was  $\pm$  eight weeks old. Against the wall of the embryo sac the first layers of endosperm cells have been formed. At eight weeks, the embryo is in an early globular stage with a long, uniseriate suspensor stretching up into the micropyle (Figure 3A). The cells of the suspensor contain starch grains and extend past the nucellus epidermis into the region originally occupied by the extranucellar part of the embryo sac. It seems possible that, by elongating, the suspensor has pushed the embryo proper into the developing endosperm. At seed maturity the embryo is without chlorophyll, erect and spatulate with thin, expanded cotyledons and lies imbedded in oily endosperm.

*Seed coat*: in *Dovyalis caffra* the seed coat is not multiplicative, i.e. periclinal divisions do not occur during seed development to add extra layers to the seed coat. Since the only mechanical layer in the mature seed coat develops from the outer epidermis of the inner integument, the seed is exotegmic.

In the early stages of seed coat development (Figure 3B, D), the testa comprises about four to five cell layers, except in the raphe region where the mesophyll is multilayered (Figure 3B). The mesophyll and inner epidermis of the testa consist of thin-walled parenchyma. The outer epidermis of the testa possibly plays an important part in the protection of the seed before the mechanical layer of the tegmen matures. After fertilization, numerous thin-walled, unicellular epidermal hairs are formed which cover the young seed (Figure 3B, D) at the early globular stage of the embryo (Figure 3A). The hairs grow perpendicular to the seed surface (instead of becoming

depressed) and eventually permeate the space between the seeds and the pericarp. The hairs possibly guard against desiccation of the inner seed tissues by preventing the loss of water vapour through the numerous stomata in the epidermis of the testa (Figure 3D). Apart from the hairs, the outer epidermis also contains large numbers of tanniferous cells with walls impregnated and lumina filled with phenolic compounds. These polyphenols increase the rigidity of the thin epidermal cell walls and contribute towards the hardness of the seed coat (Werker 1997: 100). Phenolic-containing cells offer resistance to biodegradation and help to protect against attacks by herbivores, insects and micro-organisms (Boesewinkel & Bouman 1984). In the ripe fruit the outer epidermis with its hairs persists, but the phenolic substances have disappeared and the cells of the mesophyll and inner epidermis collapse (Figure 3C).

At the onset of seed coat development, the tegmen consists of about five layers (Figure 2E). The outer epidermis of the tegmen (exotegmen) show frequent anticlinal divisions to form a single layer of thin-walled, radially flattened cells (Figure 3D) that rapidly stretch in a direction parallel to the longitudinal axis of the seed (Figure 3B). The inner epidermis of the tegmen (endotegmen) also divides anticlinally and forms a layer of small, tightly packed cells containing large amounts of dark-staining phenolic substances (Figure 3B, D). In the ripe fruit the exotegmen forms the mechanical layer of the seed and comprises thick-walled, radially flattened cells (Figure 3C) with cell walls impregnated with phenolic compounds. The mesotegmen has disintegrated and the endotegmen remains as small, strangely formed flask-shaped cells adjacent to the persistent nucellus epidermis that separates the endotegmen from the endosperm (Figure 3C).

### DISCUSSION

A detailed comparison of ovule and seed characters in the 36 families placed by Savolainen *et al.* (2000) in Malpighiales—the clade previously termed Violales (Chase *et al.* 2002)—is hampered by a lack of comparable data for many of the families, as given in compendia dealing with comparative embryology. Nevertheless, according to such works (Davis 1966; Corner 1976; Johri *et al.* 1992; Nandi *et al.* 1998) similarities include bitegmy, anatropy and crassinucelli with the nucellus epidermis participating in the formation of the nucellus cap (tenuinucellate in Clusiaceae, Dichapetalaceae, Linaceae, Ochnaceae, Trigoniaceae); both integuments usually form the zigzag micropyle canal (inner integument only in Dichapetalaceae, Erythroxylaceae, Rhizophoraceae, outer integument only in Salicaceae *sensu stricto*); a *Polygonum*-type embryo sac usually develops, but *Allium*- and *Adoxa*-types also occur; endosperm formation is nuclear, it later becomes cellular and is usually copious (exalbuminous seeds in Caryocaraceae, Clusiaceae, Ochnaceae, Salicaceae *sensu stricto*); the embryogeny varies considerably, but the mature embryo is typically straight, medium-sized to large and protected by a fibrous exotegmen in the seed coat (mesotestal seed in Clusiaceae, exotestal in Dichapetalaceae, Salicaceae).

As far as embryology is concerned, *Dovyalis* seems to fit comfortably into the framework of Malpighiales (com-



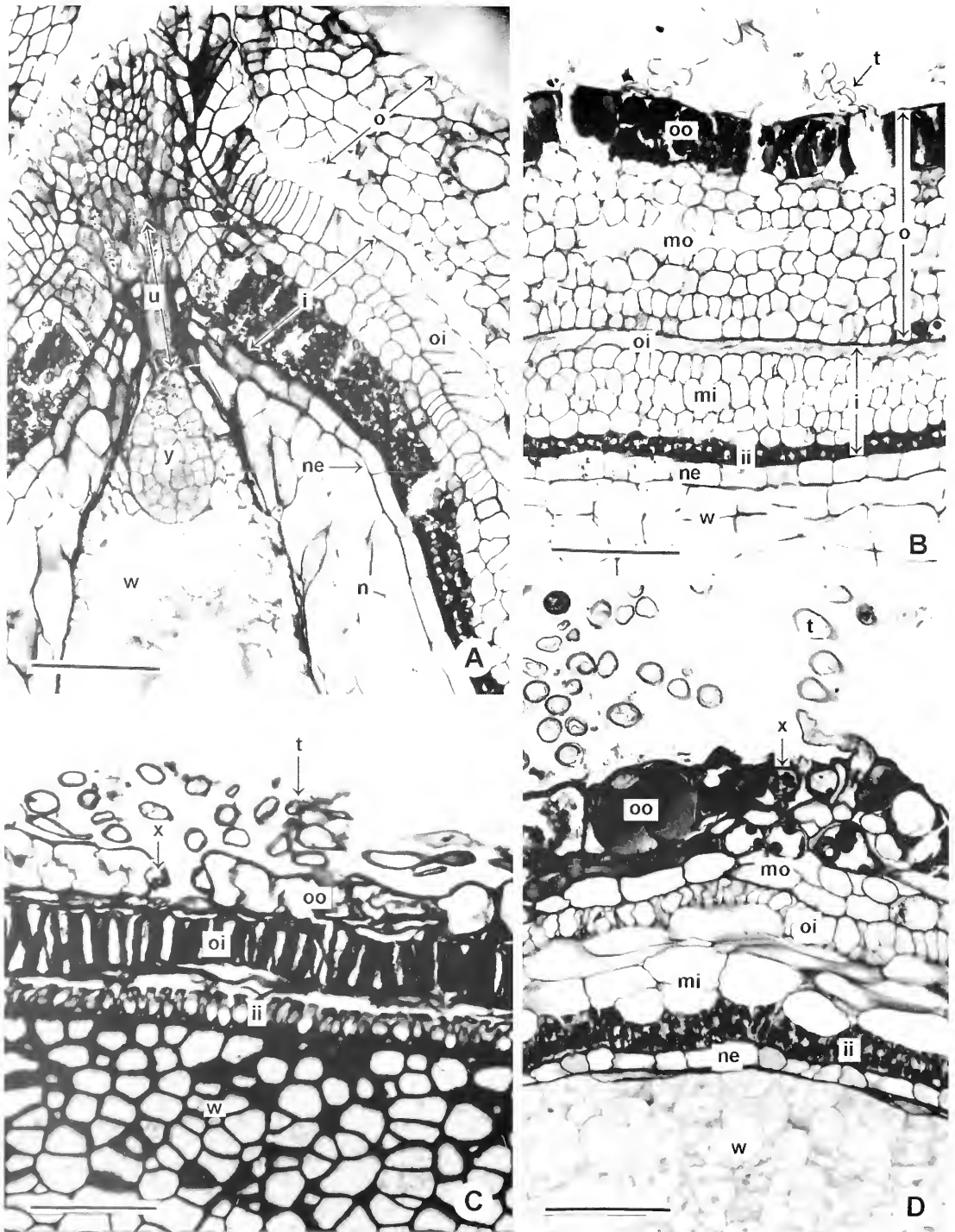


FIGURE 3.—Seed and seed coat formation in *Doyyalis caffra*. A, micropylar region of young seed with developing embryo, note long suspensor in micropyle; B, l/s developing seed coat; C, t/s seed coat of seed in ripe fruit; D, t/s developing seed coat. i, inner integument (tegmen); ii, inner epidermis of tegmen; mi, mesophyll of tegmen; mo, mesophyll of testa; n, nucellus; ne, nucellus epidermis; o, outer integument (testa); oi, outer epidermis of tegmen; oo, epidermis of testa; o, testa; t, epidermal hair; u, suspensor; w, endosperm; x, guard cell of stoma; y, embryo. All scale bars 10 µm.

TABLE 1.—Comparison of selected ovule and seed characters in *Dovyalis* and *Salix*

No. Character	<i>Dovyalis</i> (according to present study)	<i>Salix</i> (according to literature)
1. Ovule position and number	Parietal, multi-ovular	Parietal, multi-ovular (Chamberlain 1897; Judd <i>et al.</i> 2002: 281; Steyn <i>et al.</i> 2004)
2. Ovule type	Anatropous, bitegmic, crassinucellate	Anatropous, unitegmic, crassinucellate (Chamberlain 1897; Meeuse 1975; Johri <i>et al.</i> 1992; Steyn <i>et al.</i> 2004)
3. Outer integument	4- or 5-layered, parenchymatic, forms exostome in seed	3- or 4-layered, parenchymatic, forms micropyle canal (Steyn <i>et al.</i> 2004)
4. Inner integument	4- or 5-layered, parenchymatic, forms endostome	Absent (Corner 1976; Judd <i>et al.</i> 2002; Steyn <i>et al.</i> 2004)
5. Funicle	Absent, ovule and seed sessile	Present, ovule and seed stalked, (Chamberlain 1897; Steyn <i>et al.</i> 2004), or without funicle (Corner 1976) (not confirmed)
6. Nucellus cap	Comprises derivatives of both nucellus epidermis and parietal cell	Comprises derivatives of both nucellus epidermis and parietal cell (Chamberlain 1897)
7. Embryo sac type	Usually bisporic <i>Allium</i> -type, rarely <i>Polygonum</i> -type, extranucellar	Monosporic <i>Polygonum</i> -type (Maheshwari & Roy 1951); <i>Allium</i> -type, extranucellar (Chamberlain 1897)
8. Seed type	Anatropous, albuminous exarillate	Anatropous, exalbuminous (Corner 1976), arillate (Steyn <i>et al.</i> 2004)
9. Endosperm	Nuclear becoming cellular, oily, copious in seed	Nuclear becoming cellular, oily, absent in seed (Martin 1946; Corner 1976)
10. Embryo	Large, erect, spatulate; cotyledons thin, non-chlorophyllous	Large, erect, spatulate (Martin 1946); cotyledons thick, chlorophyllous (Steyn <i>et al.</i> 2004)
11. Embryogeny	Type unknown; suspensor present	Asterad-type (Davis 1966); suspensor present (Chamberlain 1897)
12. Seed coat	Exotegmic, consists of longitudinal fibres; stomata and hairs in epidermis of testa; exarillate	Exotestal; epidermis of testa with thickened walls, glabrous without stomata; hairy aril present (Steyn <i>et al.</i> 2004)
13. Dispersal mechanism	Endozoochory	Anemochory, hydrochory, epizoochory (Ridley 1930: 554; Steyn <i>et al.</i> 2004)

pare Table 1: Nos 2, 3, 4, 6, 7, 8, 9, 10 & 12). Reports in classical literature (Davis 1966; Corner 1976; Johri *et al.* 1992) indicate that the genus also shares many of the above-mentioned characters with other representatives of the Flacourtiaceae, e.g. *Arechavaletia uruguayensis* Speg., *Ilesia polycarpa* Maxim., *Flacourtia indica* (Burm.f.) Merr. However, features that seem to stand out as particular to Flacourtiaceae include the following: an embryo sac that breaks through the nucellus and protrudes into the endostome, a variation in the functional behaviour of the megaspores and a fibrous exotegmen in the seed (Johri *et al.* 1992). These are also characters that proved to be definite for *Dovyalis* in the present study.

Embryological studies on *Salix* and *Populus* L. (Chamberlain 1897; Maheshwari & Roy 1951; Nagaraj 1952; Steyn *et al.* 2004) partly support the placement of Salicaceae *sensu stricto* in Malpighiales (see Table 1: Nos 1, 2 (partly), 3, 6, 7, 8 (partly), 9 (partly), 10 (partly), 11). It is noteworthy that two other embryological characters of diagnostic value for Flacourtiaceae, namely the unusual extranucellar embryo sac and the inconsistent behaviour of the megaspores, are also characteristic for both *Salix* and *Populus* (Chamberlain 1897; Nagaraj 1952). Furthermore, the hairy seed coat in *Dovyalis* may be taxonomically significant. Although the seed itself is glabrous in *Salix*, the genus is characterized by the presence of long, unicellular, intra-ovarian hairs as well as seed with a hairy aril (Steyn *et al.* 2004). This propensity to produce epidermal hairs in the ovary and its associated structures such as ovules, seed and arils may well reflect a close phylogenetic link between Flacourtiaceae and Salicaceae.

Despite all the similarities between *Salix* and *Dovyalis*, significant deviations of the basic flacourtiaceous pattern also occur. In *Salix* the endosperm is ephemeral (Håkansson 1954), the seed exalbuminous and exotestal and the inner integument absent. Unitegmy results in the lack of an endostome and the absence of a tegmen with its characteristic fibrous exotegmen. Steyn *et al.* (2004) suggested that the marked differences in seed coats between *Salix* and animal-dispersed flacourtiaceous taxa like *Dovyalis* may possibly be linked to seed adaptations for different dispersal strategies—*Salix* seeds are mostly dispersed by wind and water, mechanical layers would only unnecessarily increase seed weight, whereas *Dovyalis* seed occur inside edible berries and need the protection of exotegmic fibres against the onslaught of animal feeders.

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## Miscellaneous notes

### AGAPANTHACEAE

#### CHROMOSOME COUNTS IN THE GENUS *AGAPANTHUS*

##### INTRODUCTION

The genus *Agapanthus* L'Hér. consists of ten species (Archer 2003), widely distributed in southern Eastern Cape, southern Western Cape, southern KwaZulu-Natal, Swaziland, Mpumalanga, Free State, Lesotho, Gauteng, Limpopo and Mozambique (Duncan 1998).

Very little morphological variation exists in the genus and the delimitation of species is mainly based on flower type and whether the taxon is deciduous or not (Leighton 1965). The species also hybridize quite freely when grown next to each other (Duncan 1998). Human intervention (selection) and especially the production of numerous cultivars (often resulting from interspecific hybrids) blur species lines. The extent of natural hybrids is not known.

The objective of this study was to determine somatic chromosome numbers in various subspecies and cultivated varieties of *Agapanthus*.

##### MATERIALS AND METHODS

Seeds of species of *Agapanthus* collected in the wild or cultivars obtained from nurseries, were germinated in a greenhouse at the University of the Free State, South Africa. Germinated plants were watered heavily a day before collecting the root tips. Root tips were treated with cold water at 4°C for 48 hours (Jong 1995). Then the root tips were fixed in Carnoy's fixative (Carnoy 1886) for 72 hours. The Carnoy's fixative was replaced by 70% ethanol. Root tips were hydrolysed with 1N hydrochloric acid for seven minutes and stained with Feulgen reagent for two hours in darkness (Darlington & La Cour 1976). The root tips were stored in 30% alcohol until squashing. Cover slips were treated with Mayr's albumen and squashes were made in aceto-orcein according to Darlington & La Cour (1976). Contrast between chromosomes and the cytoplasm was intensified by adding 45% acetic acid, saturated with iron acetate (Thomas 1940). Slides were made permanent by floating the cover slip off in acetic acid, dehydrating in alcohol and mounting in Euparal (Darlington & La Cour 1976).

Observation of the slides was done with an Olympus CH2 light microscope. Cell positions were located with an England Finder. At least ten cells per specimen were studied. Chromosomes in the cells were photographed with a Cool Pix digital camera, mounted on a Nikon Microphot FXA microscope.

##### RESULTS AND DISCUSSIONS

Results were obtained from five species, nine subspecies and 11 cultivars (Table 1). Chromosome numbers

observed for *Agapanthus campanulatus* subsp. *campanulatus*, *A. praecox* subsp. *praecox* and *A. praecox* subsp. *orientalis* support previous findings.

Somatic chromosome numbers of  $2n = 28 + 0-2B$ , 30 and  $30 + 0-2B$  were observed (Table 1). The  $2n = 28 + 0-2B$  was observed in *A. inapertus* subsp. *intermedius*. This species was also the only one with a chromosome count less than  $2n = 30$ . The species is morphologically different from other *Agapanthus* species since it is the only species with drooping flowers featuring the colours Aconite violet 937/3 and Victoria violet 738 (Leighton 1965).

Chromosome counts of  $2n = 30$  and  $30 + 0-2B$  were the most frequent for the studied taxa and agree with previous observations (Guignard 1884; Belling 1928; Darlington 1933; Geitler 1933; Stenar 1933; Matsuura & Suto 1935; Mookerjee 1955; Lima-de-Faria & Sarvella 1958; Sharma & Sharma 1961; Riley & Mukerjee 1962; Sharma & Mukhopadhyay 1963; Vijavalli & Mathew 1990). B-chromosomes were present in all species of the genus. Chromosomes were considered to be B-chromosomes if the number of chromosomes varied between different unbroken cells of the same individual. However, not all subspecies of a species or all cultivated forms had B-chromosomes. In some cases these B-chromosomes occurred in taxa where they have not been described previously (Table 1). This study did not focus on the occurrence of B-chromosomes, therefore it was difficult to determine if B-chromosomes occur in all *Agapanthus* specimens and whether they are restricted to any part of the soma. It was also observed that the karyotype of *Agapanthus* comprised of chromosome pairs of different sizes.

The chromosome counts indicated that the basic chromosome number for *Agapanthus* is  $x = 15$ , with a reduction to  $x = 14$  in at least *A. inapertus* subsp. *intermedius*. This is a high basic chromosome number and suggests a palaeoploid origin for *Agapanthus*. This study therefore added new information for *Agapanthus*, since Darlington (1933) only reported on the basic chromosome number of  $x = 15$ .

Further studies are needed to test the relationships in *Agapanthus* and especially the function (if any) and origin of the B-chromosomes. The other four species of *Agapanthus* should also be studied to determine their chromosome numbers and to see whether other basic chromosome numbers may be present.

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TABLE 1.—Specimens of *Agapanthus* taxa studied with their somatic (2n) chromosome numbers and voucher numbers or source

Taxon	2n	Voucher no. /source
<i>A. africanus</i> (L.) Hoffmanns.	30	Geitler 1933; as <i>A. umbellatus</i> : Guignard 1884; Belling 1928; Darlington 1933; Matsuura & Suto 1935; Mookerjee 1955; Lima-de-Faria & Sarvella 1958; Sharma & Mukhopadhyay 1963; Vijavalli & Mathew 1990
<i>A. africanus</i> (L.) Hoffmanns.	32	Stenar 1933
<i>A. campanulatus</i> F.M.Leight. subsp. <i>campanulatus</i>	30	Spies 7391; Riley & Mukerjee 1962
<i>A. campanulatus</i> F.M.Leight. subsp. <i>patens</i> * (F.M.Leight.) F.M.Leight.	30	Spies 7401
<i>A. caulescens</i> Spreng. subsp. <i>angustifolius</i> * F.M.Leight.	30 + 0-2B	Spies 7388
<i>A. comptonii</i> F.M.Leight. subsp. <i>comptonii</i> *	30	Spies 7399
<i>A. comptonii</i> F.M.Leight. subsp. <i>longitubus</i> * F.M.Leight.	30	Spies 7389
hybrid 424/82	30 + 0-2B	Spies 7400
<i>A. excelsus</i>	30	Matsuura & Suto 1935
<i>A. globulosus</i>	30	Sharma & Sharma 1961
<i>A. inapertus</i> P.Beauv. subsp. <i>intermedius</i> * F.M.Leight.	28 + 0-2B	Spies 7398
<i>A. inapertus</i> P.Beauv.	30	Sharma & Sharma 1961; Riley & Mukerjee 1962; Sharma & Mukhopadhyay 1963
<i>A. minimus</i>	30	Riley & Mukerjee 1962
<i>A. praecox</i> Willd. subsp. <i>minimus</i> Nana*	30 + 0-2B	Spies 7393
<i>A. praecox</i> Willd. subsp. <i>minimus</i> Storms River*	30	Spies 7386
<i>A. praecox</i> Willd. subsp. <i>orientalis</i> (F.M.Leight.) F.M.Leight.	32 + 2B	Riley & Mukerjee 1962
<i>A. praecox</i> Willd. subsp. <i>orientalis</i> Blue*	30 + 0-2B	Spies 7383
<i>A. praecox</i> Willd. subsp. <i>orientalis</i> Blue & white*	30 + 0-2B	Spies 7390
<i>A. praecox</i> Willd. subsp. <i>orientalis</i> White*	30	Spies 7387
<i>A. praecox</i> Willd. subsp. <i>orientalis</i> Weaver*	30 + 0-2B	Spies 7392
<i>A. praecox</i> Willd. subsp. <i>orientalis</i> Mt Thomas*	30 + 0-2B	Spies 7396
<i>A. praecox</i> Willd. subsp. <i>praecox</i>	30	Spies 7394
<i>A. praecox</i> Willd. subsp. <i>praecox</i>	32	Riley & Mukerjee 1962
<i>A. praecox</i> Willd. subsp. <i>praecox</i> Azure*	30	Spies 7385
<i>A. praecox</i> Dwarf white*	30 + 0-2B	Spies 7395
<i>A. praecox</i> Floribunda*	30	Spies 7403
<i>A. praecox</i> Medium white*	30 + 0-2B	Spies 7384
<i>Agapanthus</i> L'Hér. sp.	29 & 30 + 2B	Riley & Mukerjee 1962

\* first chromosome no. report.

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## Book Reviews

MEDICINAL PLANTS TRADED ON SOUTH AFRICA'S EASTERN SEABOARD, by D. VON AHLEFELDT, N. CROUCH, G. NICHOLS, R. SYMMONDS, S. MCKEAN, H. SIBIYA, & M.P. CELE (edited by Prof. K.D. Gordon-Gray). 2003. *Ethekeeni Parks Department*, P.O. Box 3740, Durban 4000, and *University of KwaZulu-Natal*, Private Bag X54001, Durban, 4001. Pp. 267. Soft cover: ISBN 0 620 31569 5, price R150.00.

*Medicinal plants traded on South Africa's eastern seaboard* is a comprehensive and scientifically accurate photographic guide to 330 of the most commonly traded medicinal plants in Durban's informal *muti* markets. The book aims to assist in the identification of fresh, dried and often fragmentary plant parts displayed in these markets and in many other urban markets in the region. The correct identification of these plants is essential for further scientific investigation and, most importantly, conservation planning and action.

The authors represent a wide range of fields of expertise including systematic botany, ethnobotany, horticulture, conservation and traditional health care and are highly qualified for such an undertaking. The book is the result of 15 years of collaborative research under the umbrella of the Indigenous Plant Trade Research Associates of Durban (IPTRAD) working group, a group with a common interest in medicinal plant conservation. Other than traditional healers and medicinal plant traders themselves, institutional collaborators include eThekweni Municipality (Silverglen Medicinal Plant Nursery), Ezemvelo KwaZulu-Natal Wildlife Nature Conservation Services, the Ethnobotany Unit of the National Botanical Institute [now South African National Biodiversity Institute], and the University of Natal, Durban [now University of KwaZulu-Natal].

Traditional health care requirements in South Africa create a huge demand for hundreds of medicinal plant species sold in informal street markets and 'African chemists' in many towns and cities throughout the country. The trade in medicinal plants is probably greater now than at any time in the past and is one of the most complex resource management issues facing conservation agencies, health care professionals and resource users in South Africa today. It is acknowledged that the harvesting of traditional medicinal plant material is a serious threat to biodiversity in the region; on the other hand, the trade not only provides healthcare for millions of consumers, it is also critical for the welfare of all the people engaged in the industry.

A visit to any of these *muti* markets reveals a mind-boggling array of plant (and animal) parts displayed for sale, usually in the open air on street pavements. The majority of the plants are impossible to identify without seeing the plant in habitat or at least fresh parts thereof. Vernacular names can be useful for identification but can also cause great confusion as they are often applied in a general sense. For example, a single name, *ubulawu*, refers to a suite of unrelated plant species used for ritual washing. This book will go a long way towards solving such perplexities but will however also invite new inquiries and facilitate further research. It is hoped that future research results will be translated into improved management strategies that go towards ensuring the long-term survival of these species, as well as ensuring that they remain accessible to those who rely on their trade for health care and livelihoods.

A book of this nature is long overdue and the authors are to be congratulated on producing this useful, pocket-sized, well-bound guide. This type of information is often only available in large format, elaborate scientific publications and scientific journals. It is useful to have a book that can be of interest and value to diverse interest groups such as traditional healers, herbalists, ethnobotanists, taxonomists, conservationists, anthropologists, students, ecotourists and the general public. Although the book is based on research done in the Durban area, many of the species are found throughout the southeastern coastline and it will be equally useful in neighbouring regions such as Eastern Cape. An important aspect of the book is its accessibility to non-scientists, which will help towards demystifying, understanding and improving

the often derogatory perception the general public have of the medicinal plant trade and the traders themselves.

A detailed introduction, explaining the purpose of the book and how it is laid out, includes explanatory paragraphs on the geographic scope of the book, maps, identification, names and a description of the format of individual plant entries. The book is divided into six colour-coded chapters based on the part of the plant used for medicinal purposes. These include: whole plants, fruits and seeds, climbers and creepers, succulents, bark, stems and leaves, and underground parts. Within each chapter three species are presented per page, arranged alphabetically by family, and then alphabetically by genus. Some species are repeated as different parts are used and therefore appear in the relevant chapters. Each species entry includes common and vernacular names, growth form, distinguishing characteristics, habitat, Red Data status, legal status in KwaZulu-Natal, voucher specimen numbers and a distribution map for KZN and its neighbouring areas. Each species is well illustrated with up to five photographs for some species, showing the plant in habitat as well as plant parts, as they are displayed on the market. Scale bars indicate actual size of the plants. The photographs are clear but small, with some wasted space between each. The full page could rather have been used to increase the size of the illustrations.

The uses of the plants are unfortunately not provided but the reader is referred to several books (included in the reference list) documenting medicinal plants in the region. I believe the book would have been strengthened greatly by including this information, if only broad-use categories such as used by Arnold *et al.* (2002). Notes on propagation and cultivation of the species would also have been very useful but would however, have increased the size and cost of the volume.

The main entries are followed by a comprehensive list of references, a glossary and a single index, which includes subjects, species names and vernacular names.

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SEED CONSERVATION: TURNING SCIENCE INTO PRACTICE edited by ROGER D. SMITH, JOHN B. DICKIE, SIMON H. LININGTON, HUGH W. PRITCHARD & ROBIN J. PROBERT. 2003. *Royal Botanic Gardens, Kew*, Richmond, Surrey TW9 3AB, UK. Pp. 1023. Soft cover: ISBN 1-84246-052-8, price £59.95.

This is an impressive, comprehensive publication which is packed with information, guidelines, research results, suggested research options and discussion which challenges existing hypotheses and dogma in the field of seed conservation. It is not possible to do full justice to this volume in this review, however, it is trusted that the overview presented will whet the appetites of those who have an interest in seed conservation. Plant genetic resource conservation acts as a link between genetic diversity of a plant and its utilization or exploitation by humans and it is clear that there is still much to be done to enable seed conservation to meet the challenges of the 21st Century. Furthermore, the adoption of the Global Strategy for Plant Conservation in 2003, the adoption of the International Treaty on Plant Genetic Resources in 2001 and the launch of the Global Conservation Trust in 2002 are three relatively recent, large international initiatives which have contributed to raising the profile of seedbanks.

The book is a synthesis of the proceedings of an International Workshop held under the auspices of the Millennium Seedbank Project



(MSBP), managed by the Royal Botanic Gardens, Kew, at the Millennium Seedbank in 2001. The meeting was attended by 88 delegates, including 29 MSBP collaborators from 27 countries. The aims of the workshop were to: undertake a review of what is understood about the collection and conservation of seeds and fruits of non-domesticated plant species; identify similarities and differences in the process of seed conservation for wild and cultivated species; and share progress in the seedbanking of non-domesticated plants.

Exacerbation of the loss of plant diversity, as a result of a number of factors which we are all too familiar with, such as the effects of climate change and land conversion, and building, agriculture and mining, has enhanced the role of a seedbank in the conservation of displaced diversity and feeding into plant breeding and conservation programmes. At present, seedbanking can only be effectively used for species which are desiccation tolerant.

Chapters 1–14 in the book, deal with planning and collecting seed material. The Convention on Biological Diversity (CBD), as a legal and ethical framework for seed conservation activities, is discussed. Each partnership which has been set up by the MSB with organizations in different countries is unique, to maximize the potential benefits from the partnerships. However, there are many common elements which are presented as model legal clauses, compliant with the Bonn Guidelines, to assist with the drawing up of Access and Benefit Sharing Agreements (ABSA) reflecting the characteristics and needs of the partners, while taking into account CBD implementation at national level. A helpful outline and explanation of key legal terms and conditions that may require consideration, is also provided.

Factors to be considered when planning a programme of plant genetic conservation are reviewed. There is a detailed and useful chapter which includes website addresses which can be accessed to provide guidance and suggest criteria to be used in the identification of target species for plant conservation projects. Measurable criteria such as genetic distinctiveness, probability of species extinction, threat of genetic erosion and potential economic value of a taxon are suggested. Taxa can also be selected by assembling information on geographic distribution, habitat preference, phenology, genetics and taxonomy.

GIS can assist in the planning process, although the most frequent obstacle to its use is limited data availability. The use of genetic data derived from techniques such as genetic fingerprinting, which only requires small quantities of DNA and plant tissue, offers the opportunity to study some of the rare and endangered species for which this type of information is critical. Understanding the effect of seed maturity on stability, is dealt with in chapters on specific examples such as *Milletia leucantha* and *Azadirachta indica*. Ideally seeds should be collected when they are at the point of natural dispersal. Although various crude indicators can be used to identify seed maturity, it is suggested that measuring the seed equilibrium relative to humidity and comparing this with the ambient RH, may be a useful and precise tool to identify this point. It is important that the seed collection represents, as far as possible, the genetic diversity of target populations, taking into account the ecology and distribution of the species, the geography of the collection region, the likely breeding system and pollinators, natural seed dispersal mechanisms and seed quality indicators.

Practical guidance is also provided on the collection of seed from non-desiccated species, whereas Chapters 10–15 deal with specific case studies such as the collection of seed of temperate forages, organization of targeting and collection for conservation in Namibia and Mexico, the development of the MSB conservation project in South Africa and forest seed collection in Burkino Faso.

Chapters 15–32 which deal with processing and testing, begin with a detailed review of seed and fruit structure, and cover the general principles of seed processing for storage, explaining how this work is carried out in diverse MSB collections. X-ray analysis can be an invaluable tool in determining the status of seed samples before, during or after seed cleaning. The authors, however, admit that as there is a possibility for seed to incur some genetic damage during the process, x-rayed samples are not returned to the batches. The requirement for security duplication of collections as a backup, is emphasized. In many cases, up to half of each collection has already been deposited in the country of origin. However, if suitable storage facilities do not exist in these countries, collections are held at the MSB until the country of origin requests repatriation of half of the seeds. Subsamples of seed material are not supplied to private individuals, but may be supplied to users in

organizations which carry out *bona fide* non-commercial research under a signed, legally binding Material Supply Agreement.

The MSBP is supported by the Seed Bank database (SBD), the specimen database, which holds information about every seed sample in the MSB, and the Seed Database (SID), containing taxon-based and a synthesis of information contained in the SBD together with other seed research data gleaned from project and literature searches. Taxonomically based summaries are available online for conservationists and scientists.

Principles of seed-drying methods accompanied by useful data are presented to demonstrate the potential of charcoal which, although it is not as effective as silica gel, provides an alternative as a low-cost, low-technology seed desiccant. Non-destructive measurement of seed moisture by measuring the RH of air in equilibrium with seed samples is regarded as a reliable alternative to gravimetric moisture content determination. Recommendations based on experiments are provided and alternative low-cost approaches are briefly reviewed. Statistical models to determine water content may also be used, and it is suggested that techniques such as functional genomics and quantitative genetics be further explored and assessed to determine whether they can be used to identify global markers as prognostic tools. In a discussion on aspects of desiccation tolerance and sensitivity and the handling of desiccation-sensitive seeds, the authors of this chapter emphasize the gap that exists between the current state of urgency to preserve germplasm and the lack of understanding of the phenomena leading to desiccation tolerance or sensitivity. Seed recalcitrance for example, appears to be widespread across families with little taxonomic relationship.

The theoretical and practical aspects of measuring seed germination and viability and the relative advantages and disadvantages of each type of test were assessed. There is a false impression that 'viable' seeds are synonymous with 'germinable' seeds but viable seeds are not necessarily capable of germination into normal 'seedlings'. The vital stain fluorescein diacetate (FDA) is a fast, dependable and accurate measure of viability but it can underestimate the viability of certain species such as the Orchidaceae, due to problems with stain permeability. Other approaches to test viability including the use of *in vitro* techniques for the recovery of stored embryos, are outlined. The use of molecular techniques may assist to indicate whether the problem is in the embryo or endosperm, what kind of dormancy is involved and the best method of breaking it.

Predictive classification of seed dormancy in relation to biogeography and phylogeny has highlighted that much more research is needed on within-class taxonomy of seed dormancy of many more species in all terrestrial biomes. Lastly, methods to effectively remove physiological dormancy in certain Western Australian *Acacia* species, the patterns of seed germination in response to smoke in plants from the Cape floral kingdom and the effects of temperature on Mexican cactus seed in the Sonoran Desert are also dealt with.

The final section of the book (Chapters 33–54) covers storage and utilization issues including an update on the principles of seedbank design to provide effective drying facilities for seed collections and, once dried and packaged, their maintenance at cool temperatures. Designs for these banks range from very simple ones, to cater for those with limited budgets, to those involving greater technological and financial input. As an example, a quick-testing protocol which utilizes the colour change of self-indicating silica gel was used to select suitable seed containers to be used in the MSBP.

Viability equations such as the improved seed viability equation developed by Ellis & Roberts (1980) which include constants that explain the empirical effects of moisture content and temperature on longevity, have formed the basis for *ex situ* conservation of plant genetic resources in seed banks. While the temperature constants appear to be universal, the moisture content is species specific. Seed-viability constants are available for at least 66 species from 26 families. Qualifications to the seed viability equations have contributed to the recent debate about the validity of using extrapolated predictions to determine longevities in the region of millennia for dry cold-stored seeds.

Optimized gene banking procedures are often interpreted as storing seeds under environmental conditions that give them maximum longevity. But this narrow view of optimized gene banking is difficult to define or predict because the interactions that contribute to the lifespan of a seed are not yet completely understood. The authors suggest

that the concept of optimal seed banking procedures should be broadened to include the intended use of the germplasm as well as other *ex situ* conservation steps, especially collection and regeneration schemes. Longevity of seeds has been attributed to the presence of an intracellular glassy state based on the assumption that the high viscosity of glass decreases molecular mobility and slows diffusion in cytoplasm, in turn slowing the possible harmful chemical reactions and changes in structure and chemical composition during ageing. Specific cases such as that of the Neem (*Azadirachta indica*) are discussed in more detail.

A number of gaps have been identified in the knowledge of seed biology of many Australian species and problematic dormancy is often encountered. The authors of this particular chapter have identified a number of areas for further research such as the impact of long-term storage. Mature seeds of *Mammillaria supertexta* are tolerant of desiccation to very low moisture contents and of storage at conventional seedbank temperatures, suggesting they are orthodox seeds and thus supporting the theory that *ex situ* conservation of arid and semi-arid plants is possible by means of seed storage. The impact on viability of the hydration conditions required to cryo-preserve in liquid nitrogen was investigated in non-orthodox oily seeds of nine species of coffee. The hydration window is highly variable across species but appears to correspond to seed unfreezable water content, suggesting that seed survival depended strictly on intracellular ice formation.

Ten case studies outlining aspects of seed conservation in a number of countries including Ethiopia, Spain, Greece, USA (Oregon), the Netherlands, Nordic countries, Jordan, India, Morocco and USA (Hawaii) are detailed in further chapters. The seed of plants from Hawaii displayed very low incidences of recalcitrance and it is suggested that the requirement for long distance dispersal of the original colonizers selected

against recalcitrant seeds. Oceanic islands are likely to show similar patterns suggesting that they can be stored using conventional techniques for orthodox seeds. It is notable in all these studies that the effectiveness of the work being executed is greatly enhanced through partnerships with a variety of individuals and institutions.

The concluding chapters of the book contain editorial perspectives on the future of seedbanking and a broad spectrum of ideas, concepts and approaches to seed conservation, some of which have been highlighted in other chapters, while others have been derived from other sources, with a view to encourage active debate amongst seed conservationists.

In the final analysis, the book is structured in such a way that it will contribute to the updating of current practitioners such as geneticists, plant breeders, seed biologists and taxonomists, be very useful to organizations in the process of establishing seedbanks, be valuable to students and policy makers, and also update handbooks published by the international Board for Plant Genetic Resources (IPGRI). Furthermore, as the gaps in present knowledge are emphasized throughout, potential avenues for future research are highlighted.

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- ELLIS, R.H. & ROBERTS, E.H. 1980. Improved equations for the prediction of seed longevity. *Annals of Botany* 45: 13–30.

M.M. WOLFSON\*

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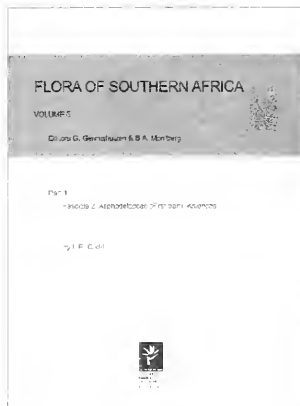




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**Vol. 5 Part 1, Fascicle 2 Asphodelaceae (First part): *Kniphofia***  
L.E. Codd (2005)

One recently described species was added to the 47 original species treatments by the late Dr L.E. Codd, former director of the Botanical Research Institute (1963–1973). A detailed key to species is followed by a description and distribution of each species, with an accompanying line drawing by Gillian Condy or a black and white copy of paintings by Cythna Letty; 25 distribution maps; a list of references; and an index to species, synonyms and excluded names. 240 × 180 mm. pp. 106.

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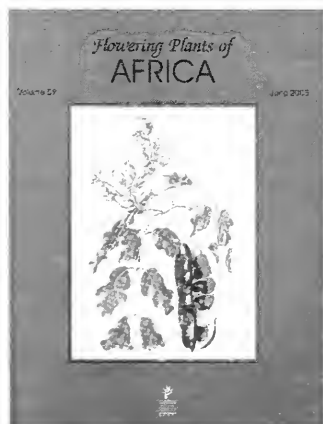
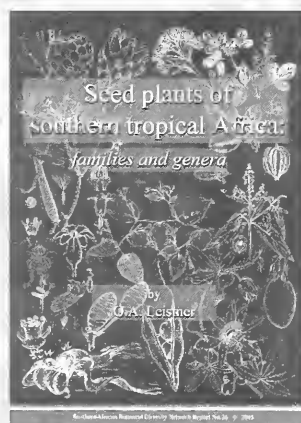
## Seed plants of southern tropical Africa: families and genera

Southern African Botanical Diversity Network Report No. 26 (SABONET)  
O.A. Leistner (2005)

This book documents the flora of Angola, Malawi, Mozambique, Zambia, and Zimbabwe. The flora of the five countries, as reflected here, comprises 228 families, 2 032 genera, and 11 637 species. The book is intended as a companion volume to *Seed plants of southern Africa: families and genera*, which covered Namibia, Botswana, South Africa, Swaziland and Lesotho, and is aimed at the serious student of our botanical diversity. It provides identification keys to all families and genera of seed plants indigenous to and naturalised in the region. Families and genera are critically described, together with notes on their distribution and size, both local and worldwide, and with lists of the most important literature. The latest views on relationships of families are reflected by means of dendrograms, and the classification of genera within the larger families is given. For easy reference, genera are arranged alphabetically within their family, and families are presented in alphabetical sequence within the three major groups: gymnosperms, dicotyledons and monocotyledons. A comprehensive glossary and an index to family and genus names conclude the work. Published by the Southern African Botanical Diversity Network (SABONET), c/o the South African National Biodiversity Institute (SANBI), Pretoria. 297 × 210 mm. pp. 498.

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